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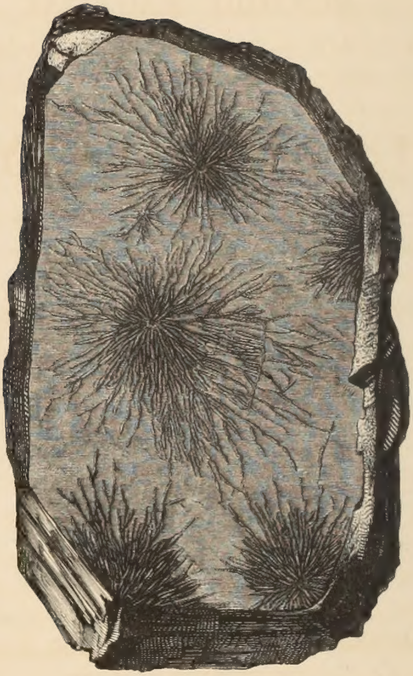

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S. J. Mackie Del.

THE GEOLOGIST;

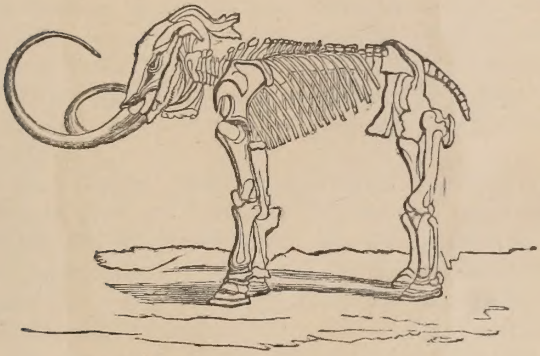
A POPULAR

MONTHLY MAGAZINE

OF

GEOLOGY.

v.1 (1858)



EDITED BY S. J. MACKIE, F.G.S., F.S.A.

"Geology, in the magnitude and sublimity of the objects of which it treats, undoubtedly ranks in the scale of the sciences next to Astronomy."—*Herschel: Discourse on Study of Natural Philosophy.*

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PREFACE.

WITH the new year I shall begin a new book, in the strong hope that more readers and more correspondents will join in aiding me in my earnest desire to popularize and to extend the noble science of geology without sacrificing, in any way, its proper dignity. The responsibility, to a conscientious mind, of a popular Magazine is not slight. Nothing once printed is innocuous or inert. There is a correlation of human passions and intellect, as of physical force, and the effects of the printed sentence may be felt in eternity. The newspaper, with all its learning, its daily interest, the labour, skill, and cost of its production, passes with the day which gave it birth, but the magazine is bound into a volume, and may be read again months or years afterwards, and become, as it often does, the first course of instruction to younger minds. To make, then, this Magazine something more than a mere mirror of passing events, has been my aim and object; and the reward of all my anxiety and care to which I have hopefully looked forward, has been to see it not only a welcome monthly visitor, but a cherished friend.

To my many friends I take this opportunity of offering my warmest thanks, but to none am I so much indebted as I am to my true and valued friend, Mr. T. Rupert Jones. For the communications of my numerous correspondents I would also return special thanks, and I desire again to express a hope that the humblest geologist in this or any other land will never hesitate to communicate anything that *he* thinks a new fact or a discovery. No one at my hands will ever meet with a rebuff for his want of knowledge or skill, and it will ever be to those only who deserve it that I shall apply or sanction the sharp words of censure.

In the interval before our monthly intercourse is resumed, the most genial season, and warmest of all the year in friendship and spirit—if the coldest in temperature—will have passed over, with the celebration of those cherished festivities in which few, indeed, willingly fail to participate.

In the expressions of good wishes at this convivial season, none will be more sincere than those which I now offer to the many friends and acquaintances which my literary labours of the past year have gathered round me.

S. J. MACKIE.

Tachbrook-street, Pimlico, Dec. 1858.

THE GEOLOGIST.

JANUARY 1, 1858.

THE GEOLOGIST, which this day makes its appearance as the popular organ of a Science which has of late years advanced with gigantic strides, and which is daily attracting an increasing share of attention from all classes of society, enters upon an unoccupied field. Its object is to supply a deficiency in scientific periodical literature. We say this in spite of the sneer which has often been uttered to the effect that no new periodical was ever issued which did not profess "to supply a long felt want." Of course new periodicals profess "to supply a want;" they are got up for that purpose; should those who bring them out think they are not "wanted," it would be sheer folly to produce them. With regard to The Geologist, there is abundant evidence that such a periodical is needed; evidence which rests not on our own judgment alone, but on the concurrent testimony of many eminently able and practical men, who have expressed their gratification at the announcement of a magazine, based upon the plan we have projected. We therefore venture to launch our first number with the full conviction that we are about to supply a work which will prove to be in a high degree useful.

In entering upon this undertaking, we desire to enlist the sympathy and aid of all lovers of Geology. We need their assistance, and we here appeal to them to render it, and to do all in their power to further this effort to promote their favourite Science. We have great confidence that in course of time, our magazine will flourish like a strong tree, but in its infancy it requires to be propped. We therefore ask all who wish to have

Geology properly represented, who desire to see erroneous notions regarding it eradicated, and correct ones established, who are anxious that it should hold the place in popular estimation which is its due, to come forward and exert themselves in ensuring the success of THE GEOLOGIST; to help to make it valuable by furnishing contributions carefully selected from the stores of their knowledge; and to provide it with the sinews of war, without which no undertaking can succeed, by procuring for it as many subscribers as they can. If our friends will give us a good start we guarantee to run the race well; we are not without friends already; we have good friends.

"Our plot is a good plot as ever was laid; our friends true and "constant: a good plot, good friends, and full of expectation: an "excellent plot, very good friends." *

We take this opportunity of thanking them, each and all, for their exertions in our behalf. For their sake as well as our own we ardently desire success. But though we have many good friends and true, we can find room for more; we cannot have too many; we want them everywhere. In every corner of the country where a labourer in the Geological field is to be found, there exists a man who has it in his power to uphold THE GEOLOGIST, and by upholding it, to foster Science. Again we say give help;—make our magazine known;—encourage and recommend it. We do not expect to perfect our plan all at once; we come forth like an insect emerging from its chrysalis case;—presently we shall gain our full powers;—one limb after another will unfold itself, and soon we shall spread our wings for vigorous flight. We shall stir up a taste for Geology, and add to the number of its votaries;—we shall create readers,—learners,—workers. In this design we are not trenching upon the province of periodicals already established. It is to be borne in mind, that they are for the most part technical, abstruse and intelligible only to the well-read man of Science;—they are intended for his use, and fulfil their intention admirably. Our work, however, is popular;—our pages are to contain such things as beginners can comprehend;—our aim is to beget students, and to supply material for them to work with. We are not attempting to compete with existing magazines; we hope to

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* Henry IVth.

see them flourish as they deserve. By creating more Geologists, we are likely to increase rather than diminish the number of their readers; we interfere with none, we plough in no man's furrow, but break a new fallow for ourselves.

We are not so conceited about our workmanship as to think it perfect, and are not reluctant to believe that it may be improved, as it goes on; we are ready to listen to reasonable complaints, eager to receive useful hints and suggestions; we will do our utmost to discover and remove defects. We wish to make our magazine really good and useful; no personal caprice or individual interests shall be allowed to interfere with our efforts to make it worthy of the great science which it aspires to represent.

Geology is a noble science, and holds a dignified position amongst natural sciences. It is pursued as a study by a section of society which, though not large, is learned. It is wondered at, and enquired about by that larger section, who knowing next to nothing of its principles, meet with allusions to it in many of the books they read; who cannot help noticing as they walk about the country, that the earth is deposited in layers or *strata*; who see fossils dug out of Railway cuttings, or who stop to gaze with astonishment, blended with incredulity, at the restorations of uncouth antediluvian creatures in the gardens of the Crystal Palace. This science, elevating alike to the rational and moral constitution of man, affords to him, whose bent is to contemplate nature, a healthy intellectual occupation and a fruitful source of mental enjoyment; it treats of questions of the deepest interest to every reflecting mind; while its practical benefits are neither few nor unimportant. To the careful observer, who trains himself to a steady scrutiny of the things and circumstances amongst which he lives; who gazes at the heavens, not to indulge in empty musings upon the stars, but to reflect intelligently upon the laws which regulate their motions; who watches living beings, not to indulge in vain speculations as to the nature of vital force, but to ascertain the plan of their construction and vital actions, and the mutual relations of their functions; who, eschewing vague reveries, examines what he sees around him by the only test to be relied upon—the test of a sound experimental philosophy; who accustoms himself to trace effects to their causes: searching for sources of error and rigidly excluding all he finds; to such a man—and is it not the duty of all of us to try to make ourselves such?—Geology presents a never failing resource wherever he may be. It may be studied in every locality, is open alike to him whose lot lies in remote rural districts, and to the denizen of cities. The surface of the whole earth, and the operations constantly in progress upon it, form the pages from which its lessons are learnt. Each cloud-capt mountain and fruitful valley; each rushing river and rippling brook; the surging ocean and the placid lake; the tide-worn sea beach and the well-tilled field, alike contribute to elucidate its mysteries. Not a lane, not a gravel-pit, not a quarry, or well, no summer's scorching heat, no winter's flood and frost, that does not furnish either the results and relics of bye-gone ages, or the key, by whose aid these may be deciphered, and their meaning interpreted. Every pebble, every grain of sand, has a wonderful history. The very dust of the ground we tread on is replete with food for thought.

If age is venerable, then do the subjects of which Geology treats command the highest veneration. The antiquary counts the years that have elapsed since the stately building, over whose ruin he ponders, was first raised towards heaven, but the Geologist can say,—"Your old building is a mere stripling, compared with the stone it is built of; I will tell you of periods when that stone itself was being made; so lengthened, so remote, that the mind is lost in amazement, in considering them; if you love antiquities, follow me, and I will show you monuments and medals, ruins and relics, that will amply gratify your love for searching into the hidden past; I will disclose to you a tale of ancient epochs, so astounding as to make one quiver with emotion in listening to it, so marvellous as to fill the mind with unmixed reverence for the great Controller of events; the all-wise and Almighty Creator of the universe."

This grand Science is intimately associated with several other natural sciences. It is indebted to them, and they to it. The Chemist and Mineralogist have here an ample field for turning their studies to account; both of them gather from Geology stores of knowledge, and yield to it valuable information; the Zoologist is enlightened by it, and sheds upon it invaluable light; the

Botanist too in his department of Natural History both confers and reaps advantages. The natural sciences are all mutually useful to each other; they are kindred branches of the one great tree of knowledge.

The practical benefits, to which we have made allusion, are set forth in detail in another part of our columns; they are many and great, and are seen in the daily useful application of Geological principles, in this and other countries.

Such is the Science we now aspire to promote. We come forward not arrogantly, as if we would dictate upon it, but with diffidence, lest we should not be able to do justice to so important a subject. We desire to elicit the results of the labours of Geologists and make them known to the world at large. We wish to make Geology—in these days of Mechanics' Institutes and Public Lectures—an object of popular enquiry and study. Surely we shall not fail through the lukewarmness of its votaries. In the name of Science we demand their co-operation. To them, to the Chemist, Mineralogist, Zoologist, and Botanist, and to all who desire to see knowledge of science diffused, we say: 'Give us 'your right hand, not as Lord Viscount Privilege did to Peter 'Simple when he was a long way off the title, (extending towards 'him just the tip of his forefinger) but give it as he would have 'done to the heir of the family;—we don't care for "the high 'breeding;"—let us have a brotherly greeting, and a hearty grip.'

THE EDITOR.

GEOLOGY *considered with reference to its* UTILITY AND PRACTICAL EFFECTS, *by the Rev. S. B. Brodie, M.A.; F.G.S.; Vice-President of the Warwickshire Naturalists' Field Club.*

FIFTY years ago Geology was in its infancy; there were but few who cultivated it as a Science. Museums were scarce and collections were only to be found here and there. If an unfortunate lover of nature was seen hammering in a stone quarry, he was generally supposed to be slightly demented. So rapid, however, has been the advance in general knowledge since that time, that the Geologist in these days pursues his researches unmolested; the frequent visits to his favourite haunts cease to excite astonishment; indeed are rather regarded with favour and respect. It may now be safely affirmed, that most towns of any note have a well arranged Museum and there are usually a few scientific people in the neighbourhood. Colleges and schools have lectures on natural science; and the universities are at last fully alive to the increasing demand for scientific knowledge, which may be turned to some practical account. The establishment of the Geological Survey, with its staff of able officers and an admirable Museum of Practical Geology; and the spread of Field Clubs of natural history, in various counties, are undeniably important steps in the pursuit of science and form a bright era in its history. The student, therefore, has not the insuperable difficulties and drawbacks to contend with, in the present day, which he had to undergo formerly. It is certainly a step in the right direction, and a matter for congratulation, that Geology is more favourably regarded than it used to be, and we hope to see the day when it may be made a branch of education generally throughout the country. Still it is not to be denied that there are numbers of well meaning and estimable people, who not only underrate its utility and importance, but who reject most of its well-established facts, looking upon many of them as dangerous and visionary. This is not simply confined to the religious question respecting the original creation of the world and the periods of time of greater or less extent which all Geologists believe it to have occupied. But we have often heard asked "Of what use is Geology, and what are the practical results which might be expected from it?" It therefore becomes desirable to answer this question clearly and decisively, and we think we shall be doing service to the cause of truth and sound philosophy if we draw attention to some of the most prominent features of the case.

Let us look to the practical results which Geology has accomplished, and they certainly are not insignificant. They must satisfy every candid inquirer that its main object is not the mere breaking of stones or the collection of specimens. Even its theories, when based upon sound premises, are of great and essential service.

It has also a most extensive influence on nearly every department of science and art, and hence, of late, the study of Economic Geology has been more widely sought after and appreciated. In this department the practical fruits of the Science are most apparent, and the advantages arising from a correct knowledge of the internal structure of the earth are particularly impressed upon us, and every year may be expected to increase its popularity, as its utility becomes more widely known. The study of minerals and metals belongs, strictly speaking, to the Mineralogist, but the Geologist must be acquainted with the conclusions arrived at by the former. The direction of veins, the faults which affect them, and the probable richness or poverty of the strata in which the various ores occur, is the more immediate and legitimate work of the latter. The importance of an exact acquaintance with this portion of Geological research cannot be overrated, and those who really understand the difficulties to be overcome will best appreciate the benefits which this noble science has conferred.

This Science becomes of value in regard to the Carboniferous deposits, which, being generally deep-seated in the earth, and much disturbed by faults, are worked with considerable difficulty. The aid of the Geologist is of great service in deciding the direction of the strata, and the thickness, extent, and quality of the seams. The enormous consumption of coal, and its inestimable value for economical purposes, render its extent and ultimate exhaustion a momentous and very interesting question. Happily, this has been satisfactorily answered by many eminent Geologists, who have shewn that there is coal enough yet to last for centuries, so that we need not feel any alarm on that head. Many fruitless attempts have been made in different parts of the country, to sink for coal where no one, with any knowledge of the nature of the surrounding Geological formations, would ever have dreamt of attempting it. If persons of competent authority had been consulted, no such errors could have been committed, and many thousands of pounds would have been saved. Formerly, perhaps, it might have been in some instances difficult to find an able practical Geologist at hand, but now no such excuse can be urged, since the Geological Government Survey has been established on purpose to decide questions of difficulty as they arise, and to employ the efficient means at their command for the benefit of the public.

The phenomena of Springs is another important consideration, inasmuch as from them we derive our purest supply of water, the abundance and quality of which has everything to do with the sanitary condition of our large towns. Now, since the certainty of procuring a sufficient quantity of water depends upon the inclination and character of the various beds of sand, stone, or gravel through which the rain percolates, it is requisite that this should be correctly understood before wells are sunk or reservoirs made. To determine this is one of the especial and most serviceable labours of the Geologist. In illustration of this we may refer to an able paper by Mr. Prestwich, on the water-bearing strata in the London clay with reference to the water supply of the metropolis.

In the selection of building materials a most necessary enquiry is "where can good, lasting building-stone be obtained?" The selection of the best for the purpose, is most essential, and can only be effected by a thorough knowledge of the structure and properties of the rock from which it is to be taken. Oxford is a memorial of the choice of a defective stone, and other instances of a similar kind might be mentioned.

Of late years the application of geology to agriculture has assumed an importance it justly deserves, and as the productive or nonproductive power of soils depends in most cases upon the different constituents of the rocks themselves, it is necessary to understand their mineralogical character as well as their chemical ingredients.

Thus Professor Buckman, in a very interesting paper on the Cornbrash* in the neighbourhood of Cirencester, in Gloucestershire, has shewn the varying value of three different brashy soils, belonging to the Cornbrash, Great oolite, and Inferior oolite respectively; the first of which yields the most abundant produce. He also points out how "a successful farmer near Cirencester had converted a 'brash farm,' (usually a term of reproach) into one of the most productive ones in the district." Hence we may infer the great practical advantage of sufficient geological and chemical knowledge in all farming operations.

The drainage of lands is of no little consequence, both as regards the healthy condition of a neighbourhood, and the due cultivation of the soil. In general the deepest drains do not penetrate beyond the mere superficial deposits immediately overlaying the stratum on which they repose, though very often, where the surface soil is thin, the former is cut through to a greater or less extent. In either case, it comes within the province of the Geologist to determine the variable dip, thickness, and structure either of the surface soil or substratum, as it affects the question at issue.

Allusion here might reasonably be made to the valuable properties of rocks for some other economical purposes, such as lithography, lime, bricks, and roads;† in many cases they even form an available and excellent manure, some of which, as the Crag in Suffolk, is largely exported for this purpose.

Much of this has been perhaps discovered without the aid of Geology, but a good practical Geologist cannot fail to enlarge the sphere of observation, pointing out fresh localities, which his well-practised eye and scientific experience alone could have detected, besides giving other valuable information in relation to various points which would escape the notice of a superficial observer.

We have only briefly alluded to these subjects which relate more especially to Economic Geology, but we hope we have said enough to show its value and importance, and to point out some at least of the practical results which it has produced, and which have no small influence on the welfare and prosperity of the country. There is, however, another consideration upon which we have not touched, viz., the training and culture given to the mind by all scientific pursuits. If Geology did no more than this, it would do a great deal, and would justly hold a high place as a branch of learning. But this is not all; Geology tells us of the history of God's Creation in ages long since passed away, the records of which are only to be found in the rock masses which form the crust of the globe. Now, any thing which gives us a clearer insight into the works and ways of the Omnipotent Ruler of the universe carries with it a moral lesson and a divine philosophy which will have a practical effect upon a thoughtful and well-disciplined mind. We cannot decipher the testimony of the rocks without knowing something about the nature and character of the animals and plants which not only helped to form them, but, in most cases, actually compose them. But as these are generally merely the relics of a former world, we cannot read these records aright without some knowledge of existing forms of animal and vegetable life. We have here, therefore, an additional motive for Geological pursuits; for the study of natural history, whether past or present, is both useful and pleasurable.

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* Proceedings of the Cotswold Naturalists' Club, vol. i. 1853.

† In addition to these may be enumerated the cement stones in the London clay, and the manufacture of sulphuric acid from the pyrites contained in this formation; the value of ironstones generally both in the Inferior oolite and Lias, and in the Carboniferous series; the importance of the alum shale in the Lias at Whitby, and the manufacture of Carbonate of Magnesia from the Mountain limestone of Ireland.

While Geology thus has its uses and recreations, it demands laborious thought at home, as well as a quick eye and a ready hand in the field; for although it may not be necessary that the Geologist should be a master of Mineralogy, Chemistry, Botany, and Zoology in all its branches, yet he cannot safely remain ignorant of their general principles and facts, so far as they bear upon the history of the ancient world. It has already conferred many lasting benefits on mankind, and will, no doubt, as our knowledge is enlarged and error removed, add many more. False and dangerous theories have, indeed, been from time to time propounded, and occasional mistakes have been made, but the purest wisdom—the highest earthly knowledge—must sometimes be found wanting; this is inevitable in the lot of a finite being like man, and is not the fault of the particular science or study from whence it seems to emanate. When the Geologist reasons from well-established facts, which are open to all who choose to grasp them, he need not be afraid of the ignorant prejudices and false accusations which have sometimes assailed him. Truth is ever stronger than fiction, and must prevail; its voice will make itself heard in spite of opposition.

The Geologist stands upon a rock, and declares boldly whence it has been derived, and what it contains, even though it may be far removed from its parent source; his marvellous revelations seem like the wonders of some fairy tale, so strange and yet so true, so startling and yet so imperishable. He touches the earth with the magician's wand, and from it, at his bidding, spring forth mighty monsters of the deep, reptiles of gigantic dimensions, flying lizards of uncouth form, fish and shells, corals and sea plants, unlike their living congeners, but fulfilling a very important part in the history of the past, which would have been altogether lost and unknown except for the unlooked-for discoveries which Geology has of late years achieved. It is truly wonderful to see how from rude fragments of bone, mere remnants of a skeleton which once had life, the size and form, the structure and habits of the entire animal can be determined, and its restoration so far completed.

These are some among the many marvels of the Science; more might be added, for every day brings forth new facts of greater or less importance, which may hereafter be turned to practical account, but enough, we think, has now been said (however imperfectly) to shew that Geology claims and deserves a place second only to Astronomy itself, and that its utility and attractiveness will rather increase than diminish, as long as its reasonings are kept within the bounds of a sober philosophy, and are carried on in a spirit of honest and generous rivalry. Truth is the motto which should be engraven on the hammer of the Geologist; it will then strike with a truer aim and better results, and his studies will not be selfish and unmeaning, but will produce the noblest ends which human learning can effect, namely, the glory of God, and the welfare of his fellow-creatures.

ABSTRACT *of a Notice of a new* GENUS OF CRINOIDES, *read before Section C. of the British Association for the advancement of Science, at Dublin, August 27th,* 1857. *Presented by Professor L. de Koninck, F. G. S., of Liége; and Edward Wood, Esq., F. G. S., of Richmond, Yorkshire.*

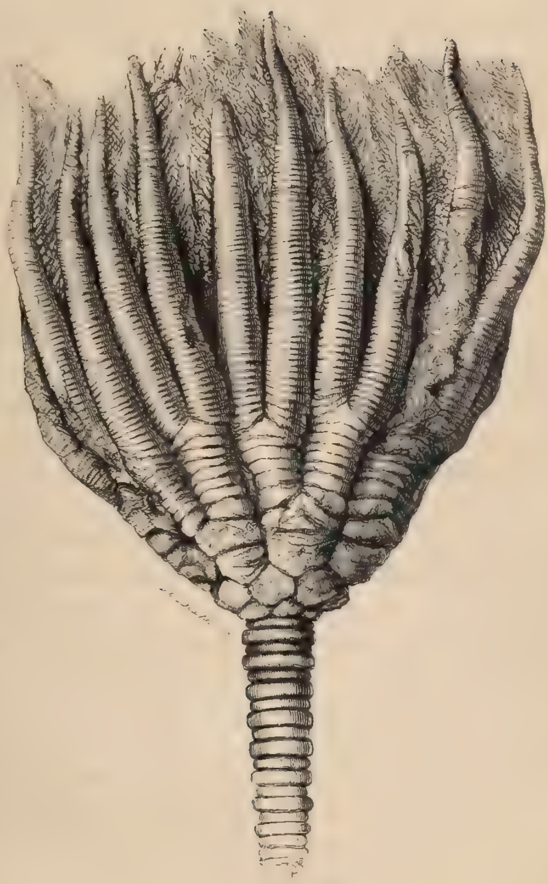
IN the year 1854, when the Genus Woodocrinus was first described, a single species only had been found. Indications of others were impressed upon the slabs, the surfaces of which were almost composed of the remains of the Crinoides. During the last three years great exertions have been made to discover all the fossils that this bed contains—and the gratifying result has been, that four or five new species have been added to that which was the type of the genus which Professor de Koninck described in a paper read before the Royal Society at Brussels, and figured in his work on the Carboniferous Crinoides.

The thin bed in which they have been found is of very limited area, being known in the district as the 'Red bed' of the Lead Miners, and is about the middle of the Yoredale Rocks of Professor Phillips's 'Mountain Limestone Geology of Yorkshire.' The strata below and above it appear to be unfossiliferous. Its locality the Carboniferous Rocks on a moor in Swaledale, near Richmond, in Yorkshire.

These Crinoides are associated with the teeth of Petalodus Hastingii; and not the slightest trace of any other fossil has yet been found with them. They lie in the bed a confused mass of stems, calices and arms, twisted and interlaced in such a manner as would lead to the idea that they are the stranded remains of these creatures, torn from their beds, or driven from the zone of water where they lived; and that the locality in which they are found was not that which they inhabited. However that may be, the ocean, of which they were denizens, swarmed with them.

The newly-discovered species are by no means less interesting than that which was the first described, and they offer some peculiarities which tend to modify and to complete the character which has been assigned to the genus.

Plate I.



WOODOCRINUS MACRODACTYLUS.—De Koninck.

Mackie

The species at present known are, Woodocrinus macrodactylus—the type species—W. expansus, W. goniodactylus, W. decodactylus, and two others. There are imperfect remains of other species, and also of another new genus, but the specimens yet found are too imperfect to permit us to form a satisfactory opinion about them.

Of all the species Woodocrinus macrodactylus is by far the most common; not more than three or four good specimens of the others having been found among the accumulated *debris* of the type species.

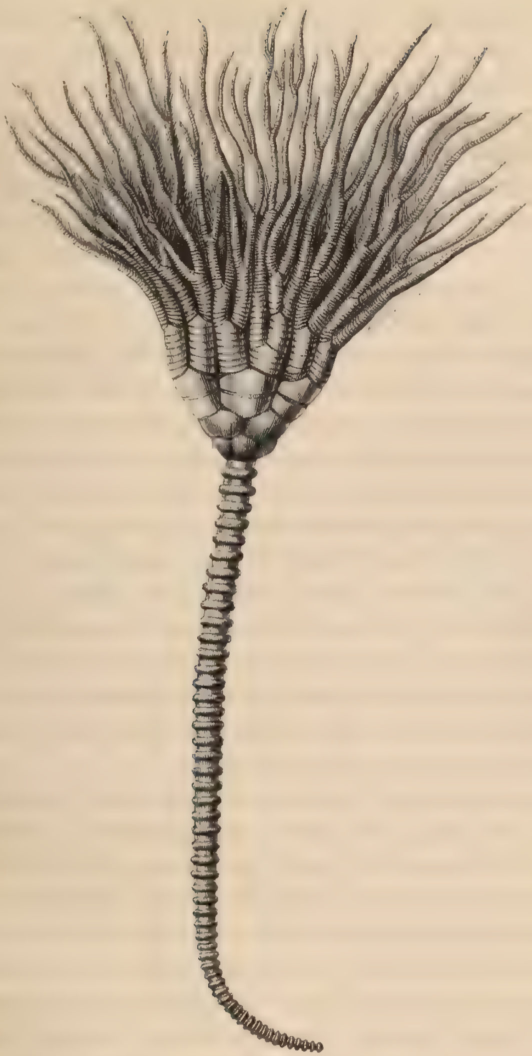
The genus, which has been named after Mr. E. Wood, of Richmond, the discoverer of the whole series, is related to the genus Cyathocrinus of Miller, Taxocrinus of Phillips, Forbesocrinus of De Koninck—differing in having five subradial plates; while the first has only four, and the second and third none. It appears also to differ from Cyathocrinus in the mode by which the second radial is attached to the first radial plate, and from the two last in having the radial joints free, instead of being united laterally by inter-radial plates. The calix or head of this genus is cup-like; generally widely opened except in Woodocrinus decodactylus, which is narrow and elongated, like a champagne glass. Woodocrinus expansus slightly differs from the others in having the shelly plates which form the cup, larger and thicker.

Like all other Crinoides, the calix is composed of a series of plates, which in this genus are quite smooth, and form themselves into a star of five rays; the base contains five plates. Alternating with these are five large hexagonal plates, called 'sub-radial;' which in their turn alternate with five pentagonal plates, called 'radial;' superposed upon which are five more radial plates, which are axillary, and from which spring two arms, which bifurcate from one to four times, according to the species. The basal and sub-radial plates are united by their lateral edges. The radial plates and arms are free.

In Woodocrinus macrodactylus the arms bifurcate but once, and are 20 in number; they are thick, cylindrical, and in appearance not unlike the common earth-worm. In W. decodactylus they are long and slender, and bifurcate twice, making the number of rays 50. In W. expansus they bifurcate three or four times, and the rays reach the number of 80, or sometimes 100. These rays are long, and very elegant; and the joints have a wedge-like form, and are so arranged that the thick end of the one corresponds with the thin end of the next. In W. goniodactylus the arms bifurcate so as to make a total of 50, while the joints differ from those of all other species in the angular formation of their dorsal aspect—the zigzag pattern formed by their peculiar style of articulations—and the thickening of the last axillary joint of each ray. The number of joints in each ray is never less than 4, and never more than 10. Each joint of these rays is furnished with a long, slender, many-jointed, flexible pinnule, which springs alternately from opposite sides of the arm, so as to make two rows. In W. goniodactylus these pinnules are more delicate than in the other species. The anal region, which is that part of the calyx not covered by the radial plates, is composed of small diversely-formed pieces; which are united above to the dome, and laterally to those plates from which the arms spring. In W. expansus these plates are fewer in number, and larger than in W. macrodactylus. The dome, which is the upper part of the skeleton, has not yet been found entire in this genus. A few plates of hexagonal and pentagonal form have been noticed; but neither its form nor size can be indicated with any certainty. It appears to be large; the plates are beautifully marked in a relief, with a star-like projection, not unlike the dog-tooth ornament which characterizes early English architecture.

The stems are composed of thin cylindrical joints, alternately larger and smaller, giving them a ring-like appearance. The thickness does not differ much in any of the species. The length is considerable, and very variable. But the special character of this stem is that, unlike the stem of all known crinoides, it is much thinner at the base than at the summit. No actual termination can be said to have been discovered; but in all the species the stem is *invariably tapering*, so that the longer it is the thinner it becomes. This circumstance would lead us to imagine, that the creature floated freely in the water, and that the stems were used to balance it, and keep it upright while it floated. Should this fact be established, it will place this genus as a link between the free Comatula and the fixed Crinoid. It may, however, have had the

PLATE I.



WOODOCRINUS EXPANSUS.—De Koninck.

S. J. Mackie Del.

power of fixing itself at will, as Dr. Buckland imagined to be the case with the Pentacrinus of Lyme Regis; or the stems may have had a fixed point of attachment; while this form was adapted to give the utmost amount of flexibility, so as to rise and fall in a tidal sea. In any case, whether floating or with the power of attaching and detaching themselves at will, or broken from their base, the fact that they were cast upon the beach when dead would account for the confusion with which they are thrown together, and for the absence of any fixed base to their stems, in case the last conjecture was found to be correct.

The remains of these creatures have been collected by hundreds, but, so far, only in this solitary district. Specimens are in most of the public and private Museums throughout England; thus proving that our conclusions have not been arrived at hastily. Many of the specimens are in a beautiful state of preservation, as the series before the meeting will fully illustrate.

On BONE BEDS *and their characteristic* FOSSILS. *By W. S. Symonds, F.G.S., President of the Malvern Natural History Field Club.*

"FOURTEEN years have now elapsed," says Sir R. Murchison, "since I proclaimed that the fishes of the Upper Ludlow Rock "appeared before Geologists for the first time as the most ancient "beings of their class; and all the subsequent researches in the "various parts of the world over which Silurian Rocks have "been found to extend, have failed to add to or modify this "generalisation."*

The Upper Ludlow fishes hold their position still, but time and experience have added somewhat to our knowledge, and whereas we formerly held that "BONE BEDS" were boundaries of Creation, —universal phenomena,—and that they marked out a certain horizon where whole tribes and races of animals were extinguished, never to be renewed, it may be useful to Geologists to sum up shortly the evidence as it *now* stands, respecting these most interesting platforms of death.

* Siluria, p. 239.

There is not in all England more lovely scenery than that around the protruded Upper Silurian dome of Hagley Park, in the village of Bartestree, five miles S.E. of the old town of Hereford, nor am I aware of any locality where the Ludlow bone bed is more charged with the relics of dead fish and Crustaceans. It was here that my late friend, Mr. Scobie, obtained the most perfect claw of the "Pterygotus Problematicus,"—that extinct Silurian lobster,—yet known to science; here Mr. Strickland found the seeds of the first known land plant, a Lycopodium, or fossil club-moss; and the only time I could ever afford an hour's work there, I obtained the finest spine of the Onchus Murchisoni, an Upper Silurian placoid fish, I have ever yet beheld; while, doubtless, the cabinets of the Geologists of Herefordshire are enriched with numerous specimens I have not seen. The members of the Woolhope Club can hardly allow so rich a bed to remain unexplored, more especially when the courteous owner of the land, Mr. Phillips, railed off the dome, and preserved it for their peculiar examination and benefit.

To return to the organisms of the bone bed; it is a curious fact that, a few months after Mr. Strickland and Mr. Salter had described the Pterygotus of the Hagley dome, Mr. John Burrow should find the jaw-foot of the same animal in beds immensely lower in the Geologic scale, even in the Caradoc sandstones below Eastnor obelisk, on the flanks of the Malverns. Thus we have evidence that this Crustacean, or one of the same genus, lived in the Caradoc Ocean. Nor is this all; the Pterygoti are found in strata far higher than the Upper Ludlow bone bed; they swarm in the Tilestones of the Kington district, where it was discovered by Mr. Banks. It is there associated with its fellow-Crustaceans, Pterygotus Anglicanus and Himantopterus, with the *Silurian* fish, Onchus Murchisoni, the new forms of, Plectrodus, Cephalaspis ornatus, Auchenaspis Salteri, and last, though not least, with the Upper Silurian fossil, the little mollusc, Lingula cornea. We ascend considerably higher on the ladder of geologic history, and near Kidderminster we find grey tilestones passing upwards into true Cornstones; here Mr. Roberts detected the Pterygotus and Eurypterus buried in the same grave with those very characteristic OLD RED fishes Cephalaspis Lyellii, and Cephalaspis

Lloydii, and the seed vessels Parkia decipiens, so well known in the Old Red of Scotland. We have not done with the Eurypterus yet! At the very summit of the Cornstones, high up on Rowlestone Hill, near Abergavenny, the Eurypterus has again been found, and these beds are two thousand feet or more above the Kington Tilestones.*

Let us now turn to the evidence afforded by the fishes of this remote epoch. We have already seen that the Onchus Murchisoni was contemporaneous with the Crustaceans that existed with the Cornstone fishes, and we know that the LOWEST Old Red strata of Scotland, contain their wing-finned fishes, the Ptericthys, and that these beds are considerably lower than Scotch strata, which envelope the Cephalaspis Lyellii, &c., so that we may very fairly argue, that the Ptericthys was contemporaneous with the fishes of the Tilestones, and with the Onchus Murchisoni.

Now in Scotland, the Ptericthys has been found in the Yellow sandstones, at the SUMMIT of the Old Red, and the base of the Coal measures; and near the Clee Hills, in Shropshire, Mr. Baxter, of Worcester detected a specimen in good preservation, in yellow sandstone, below the Mountain limestone, and the equivalent as regards age, of the Dura Den beds of Scotland, and the Cyclopteris sandstones of Ireland. Immediately above the Ptericthys beds of the Clees, the Mountain limestone is crammed with the palates and scales of Carboniferous fishes, and the yellow equivalent sandstones of Ireland and Scotland supply us with the Carboniferous fish, Holoptychius, and even the remains of Megalicthys. Indeed the Geologists of the Irish survey, with Mr. Jukes at their head, argue, and most fairly, that these yellow Cyclopteris sandstones are CARBONIFEROUS rather than OLD RED deposits, nay, even that the so-called Old Red conglomerate is a Carboniferous conglomerate, forming the base of the Carboniferous deposits.

Here arise two interesting questions; where can the Geologist point out a section in all our English district, where the "brown stones" (Upper Cornstones) are to be seen passing conformably into the Old Red conglomerate? and where, as regards Palæontological evidence, are we to draw a line of demarcation in the Palæozoic Rocks?

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* See Edinburgh New Phil. Journal, October, 1857, p. 257.

THE COMMON FOSSILS OF THE BRITISH ROCKS.

By S. J. Mackie, Esq., F.G.S.; F.S.A.; &c. &c.

CHAPTER I.

The nature of Fossils *and their value.*

In a magazine devoted especially to the propagation of Geological knowledge, it seems no infringement of its space, no deterioration of its value, that some pains should be taken to aid the student in his early efforts, and to disperse broadcast some useful elementary information, which may prove to the mass at once a source of instruction and of enjoyment, and so, by clearing the road to future and higher studies, may foster a dawning taste, and ultimately prove the means of adding many volunteers, and not unlikely even some brilliant master-minds to the ranks of Geologists, that otherwise, deterred at the outset, might perhaps have turned their attention and talents to some more accessible, if not more congenial study.

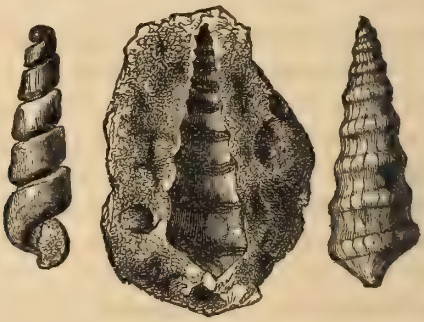
Who does not feel some interest in the past history of this beautiful world—the scene of our labours and of our loves—of our successes and of our failures—the stage of our existence and the tomb of our dust? If the animated creations of the past *were* dumb brute animals, still the earth was green and gay with trees, and plants and flowers—the hum of insects vibrated on the summer's air, and the snows of winter covered the ancient lands with their hyemal mantle—the tides of ocean rose and fell, and the world went rolling on through time and space, through years and seasons. There were earthquakes then and blazing volcanos—and winds and storms—great waves and merry dancing ripples on the sea. Even more beautiful then, perhaps, in its wildness, was this beautiful world, e'er the voice of gladness had cheered it, or the shadow of sorrow had passed over it,—e'er *man* was, and when it was God's alone!

How strange to look back into the past, how marvellous the changes, how wonderful the contrasts presented by the things which *were* and those which *are*. At one time we are regarding the myriads of small and crawling things of the primeval ocean's deeps—at another contemplating enormous reptiles of whale-like size, sporting in the broad waters of a British Ganges—or we are turning in mental revision to the herds of gigantic oxen and deer browsing on verdant plains—the associates of the hairy mammoth, rhinoceros and hippopotamus—the prey of the cave bear and hyæna; at one time contemplating the luxuriant foliage of a tropical clime, at another the floating icebergs and their stony burthens. Dream-like indeed are our visions of the past,—mysterious and solemn as our own being and existence, are the lessons which have been read in the dead language of the mountains. More unintelligible to the ignorant than alphabet of Greeks, or hieroglyphic of Egyptians, are the strange characters in which these lessons are recorded, but every letter is a volume, for these letters are fossils. Surely then, it is worth while asking, even if for the benefit of no one else than of those who have never thought about these things, —and a magazine, like a missionary, goes to strange and far distant places, and it may put the questions where they were little likely to have been put at all—What is a fossil, and what is its value?

Under the term "fossils" are included not only the mineralized remains of organic substances, but also the impressions or casts of any such bodies,—of a footprint, a worm-track, or of a rain-drop, or a ripple-mark—of anything indeed which was once part of, or was in any way associated with the existence or conditions of any living object of a past creation, and not being actually a mere rock or stone, or in other words a mineral mass.

In Geology everything is complicated—elaborated, and every fossil, like an old house, bears marks of homely changes and associations, suggesting many a train of incidents and ideas; and, as the preservation of organic remains must be vastly diversified, so with the differences in the rocks themselves, there will be also characteristic differences in the fossils. But more than this, where similar rocks have been subjected to different physical conditions, there also such differences will be manifested in the conservation of the fossil itself.

Any one who regards the aspect of a fossil will at once perceive that, although he cannot fail to recognise it as the remains of some organised being, a fragment or portion, it may be, of some fish, animal, plant, or shell, yet it is not really the actual bone, nor wood, nor shell which he sees, but these substances greatly altered from their former state, each having undergone a process of transformation in its intimate structure or its composition, which, while the resemblance of the former shape has been perfectly retained, has in reality converted it into a something very different. Fossilization is not the mere impregnation of an object with mineral matter by its long continued entombment in the earth, but it is a process, or rather a collection of processes of far more wonderful character. Particle by particle of the original organism may have been removed by the percolating waters——slowly, and in the lapse of ages; and as slowly and as constantly, particle by particle has been replaced by particle after particle of some other* and very different element; thus the lime of the calcareous shell has been often replaced by flint, or ordinary bone by carbonate of lime. Or, the dissolving waters may have absorbed the shells and have left only a hollow cavity to mark their vacant



Lign. 1. Terebra Portlandica from the Portland Oolite.

1. Cast of Interior of the Shell. 2. Mould or Impression of the Exterior of the Shell. 3. The Shell itself.

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[*] The scientific reader will be aware that in some rare instances the original condition of the organic substances appears to be retained.

burial places. Such fossils are known as *casts*, where the rock has consolidated in their interiors; and as *moulds* or *impressions* where the external forms and ornamentation are indented in the clay or stone. There are many other processes of fossilization; by some of which the most exquisite tissues have been retained, and in others even distinct evidences of colour have been conserved.

On the slightest reflection it must be apparent that where, as is by no means uncommonly the case, an organic structure of much delicacy has been preserved in the soil, the process of preservation, must have been, at least in the first instance, if not positively sudden, at least very rapid. Sometimes by an incrustation of the surface of the animal or plant soon after its death or its deposit in or upon the mud of the ancient seas, decomposition was for a time partially arrested, and the external parts thus saved from decay, while the internal have rotted away and left a cavity which may still remain, or which may have been filled up with sparry crystals, segregated from subterranean waters. At other times, as perhaps in the case of the chalk-flints, the inclosed organisms have been penetrated by the enveloping substance, the tenuity of which was often such as to have permitted its passage through the cracks and seams, and frequently even through the finest pores of the shells. So much then for "What is a fossil?"

Too many people still think Geology merely the art of collecting fossils and rocks and of getting names for them; and hundreds of those who go into a quarry, come out again with little other difference than that of being dirtier and dustier on their exit than on their entrance. The possession of a shell or even a lot of fossils is not sufficient for science; it may please the amateur or amuse the idle. Fossils are not to be hoarded as curiosities or rarities, but prized for their teachings. Go to the seaside and watch what takes place on shores which present the like conditions with the beds which have afforded your organic remains. Watch how the merry dancing waves, as they ebb away from the shore with playful dalliance, leave the impress of their last kisses on the sands; watch how the rippled furrows are ridged and streaked by the breath of the gentle winds. See how the spray or the rain spatter out miniature craters, and the worms and crawling things make their tracks upon the sand; dig out the annelide and the shell-fish from their oosy homes, and note their positions in the earth; observe the zones of various plants and living things, and how they vary with the depth of tide or the kind of soil or sea-bed, and carry back your experiences to the quarry, and then you will perceive something, and as yet something only, of the value of a fossil.

On our shores are three zones, of materials, animality, and vegetation. The sea has sorted out the sand and mud from the heavier fragments,—which the restless waves have tossed along the strand and have rounded into boulders and pebbles,—and, between the tidal marks, has left the sand, while the finer particles have been carried into the region of, and below, low water.

So too, nature presents her three zones of animal and vegetable life; and, as the briny currents have carried the still finer particles of silt into yet lower depths and more profound abysses, so nature in the deeper waters presents other zones of created beings, with characters and habits equally suited to the varied conditions of their existence. The researches of modern naturalists have shown that not only are various forms of animals and vegetables circumscribed in their geographical distribution, but that they are also limited in their *vertical* range, or in other words, are prescribed within a certain depth of the sea, or a definite elevation of the land. Most organic remains, from the very means and circumstances of their preservation, are necessarily of marine origin, because terrestial or subaerial influences are more essentially destructive in their ordinary action; and it is more rarely in comparison to the submarine operations, which are constantly at work, that those co-incidences happen by which the relics of the land, or even of the river or lake, are preserved.

Of actual depths of seas, the shell-fish or Mollusca, from the limited range of their locomotive powers, must be, next to algæ, corals, bryozoa, and other *fixed* forms, the most certain and definite in the evidence they afford; and thus it will be perceived, what an important bearing the study and knowledge of their habits, regions, and ordinary limits of depths will have in determining from the fossil species through their relations to their recent types, the conditions under which the strata, in which they are embalmed, were deposited, and the profundity of the pre-adamic seas or estuaries. As by the modifications and adaptations which are provided for the necessities of the inhabitants of the lake, river, or land, we can now assort, by means of their organization and structure, the fresh water tribes from the terrestrial or the marine, so by the like evidence in any of the past great periods of Geology, we can also, in the like manner determine those three important classes of depositary rocks, by their fossil shells alone.

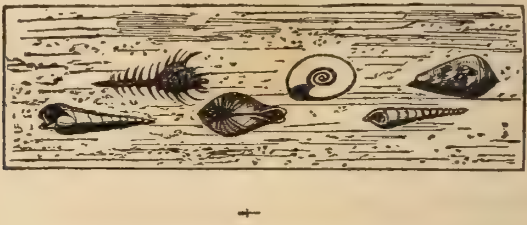
Similar inferences are ever to be drawn of ancient conditions, from every other department of Nature,—from birds and fish, mammalia or reptiles, insects or plants,—all display alike the badges of their mundane offices while living; and, changed into stone, their lifeless fragments appear self-recordant of the events and phases of their existences. Each, like a dimmed half-faded photograph, seems tinged with the lights and shadows of the scenes in which its span of life was past.

When silently we rest beneath warm and glowing skies, or in easy chair, by winter hearth and cheerful fire, how many a scene comes rolling through the mind—a vast panorama moving on and on—presenting still some fresh familiar scene. How many thousand yards of canvas, how many miles of bright and beautiful painting, are rolled up in that mysterious scroll, the memory. How fresh and vigorous, as we unroll it in our reveries, come forth the prominent faces and features, the endeared or hated spots of bye-gone days, and how time and forgetfulness have scumbled down most of the harsher details into a mysterious and delightful haze, through which those minor groups are faintly seen. How too, by instinctive perceptiveness from what we know, do we enter into the scenes coiled up within the stony forms of plants, and bones, and shells; how curiously, piece by piece, do the fragments fit together, like the scattered tessellæ of a Roman pavement, displaying in the intervals of color, outline, and vacuity, enough to manifest the tracery of the ancient floor, while as a nail, a peg, a bit of stained mortar, or a coin, complete the associations;—imagination—memory's sister,—re-builds the luxurious villa, and re-peoples it anew.

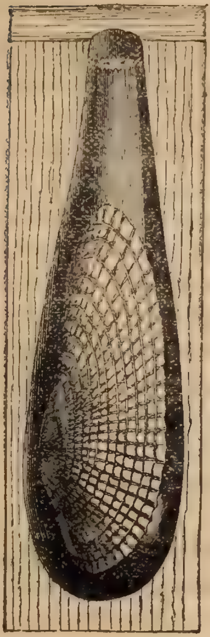
So from slight and apparently insignificant incidents are the great pictures of Geology elaborated and designed—and so does imagination in her reveries, not untruthfully and with a feeling very like remembrance, wander through the phases of those wonderful ages which have passed for ever away. Thus does even the *position* in which a fossil is found tell its tale, and is not without importance in the interpretation of the earth's history.

When from the fragments of the past creations you have discerned how to dispose the first faint lines of design, and by experience have so learned to fit them together as to comprehend or exhibit something of the beautiful tracery of those grand scenes in which Geology abounds,—you will have learned something yet more of the value of a fossil.

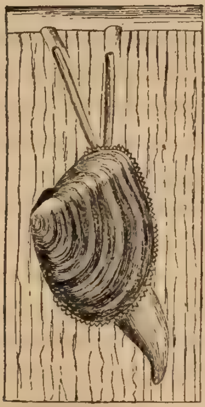
On the shores of the sea the waves in reckless confusion cast their spoils,—floating shells and wood, and the dead carcases of animals are mixed with boulders and rocks, and like the beaches and strands of to-day are the conglomerates and littoral deposits of the past—fragmentary or massive, organic or mineral, all in disorder, and contrasting with the deeper waters, where the feeble currents roll gently along the smaller shells and relics and carefully dispose them, with almost the regularity of a cemetery, in *one direction* according to their forms. True, under the influences of motion and gravitation, as the magnet to the pole, do they all point to the spot to which the current trends. Again, if in any of the ancient rocks we find the shells disposed throughout the thickness of the beds, at all levels, and in their normal manner—for all living shells have a natural position in the mud or sand, their close proximity not necessarily indicating immediate succession of deposits,—what should we infer? Shells do not rest indiscriminately on their hinges, nor their anterior nor posterior ends, but those with syphons project those organs upwards through the tubes of their burrows to inhale and exhale the aqueous fluid at once to them



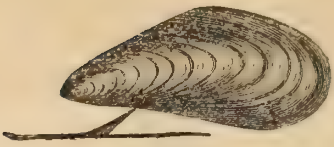
Lign. 2. Shells disposed by a current according to their forms.



LIGN. 3. Recent Pholas in its burrow in the rock.

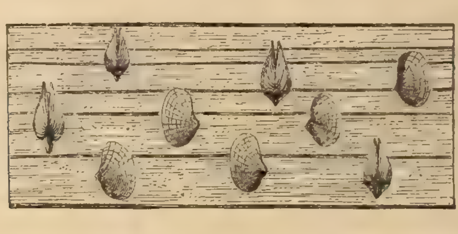


LIGN. 4. Recent Tellina tenuis in sandy mud.



LIGN. 5. Recent Mussel (Mytilus edulis) moored by its byssus.

the means of respiration and the source of food. These live *erect* in the oose, others with plated gills, like the oyster or the spondylus, rest on one of their sides, while some like the mussel or the terebratula, are moored to the bottom by a byssus or set of natural cords. Each, however, has its *normal* position, and each thus by its position in the mud or rock, tells us, more or less distinctly, where it died, whether in its native home or at some distant spot. We know too by their being disposed throughout the stratum, without regard to *special* levels, that these molluscs lived and died naturally at that very place, that the sediments growing higher and higher,—film after film piled over other,—the young fry settled above the graves of their progenitors, and like them, in course of time were enveloped by the accumulating mud to be again surmounted by younger colonies who in their turn again succumbed.



LIGN. 6. Shells at all levels in the strata of mud, shewing the gradual accumulation of sediment and the natural interment of the molluscs.

But where *all on one line* in their normal states, the fossil shells make one thin calcareous streak in the consolidated mud,

LIGN 7. Shells imbedded in a stratum of mud, all on one level, shewing the destruction of the molluscs by a catastrophe.

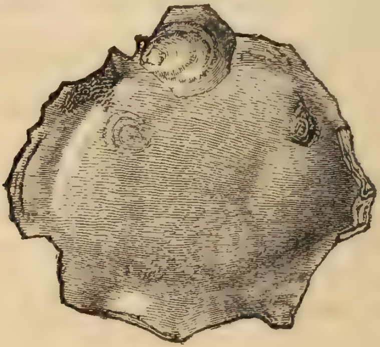
that narrow line at once speaks of the catastrophe—it is the mausoleum of young and old alike. A storm, a poisonous influence, an inundation of mud or oose may equally have effected this; but whatever was the cause the myriads were cut off at once and suddenly.

One bed of rock may immediately overlie another, and yet a great interval may have occurred between them. The distance of one bed from the other in time, may be a thousand years—or more. It may be ages,—or it may be but a day. The intimate particles of which they are composed may be silent upon this, the one may present a harder face or more consolidated constitution than the other, but of time they tell us nothing. What are days or years, minutes or hours, to the senseless particles drifted about by the changeful seas? Time *was*, however, to the perished shellfish; they might not have measured it by months or years, by days or nights, but timed were their lives, and their species. They were not in their generations from the beginning until now, but they appeared and disappeared as the succession of the beds continued, and thus each great period of Geology had its creation of animated beings and vegetation, its fauna and flora distinct and appropriate—even as ours are now. One after another have these creations passed away, and in consequence of the successive upheavals and depressions of the land, the lines of level of different shells in a quarry may, nay, often do, note the demarcation of enormous periods—periods of marvellous ages—from each other. Nor do shell-fish only tell their tales of those remote times. The bright and scaly fish, decomposing on the ocean's bed, has left a few and scattered scales, to mark its existence and decay; or a few isolated teeth, may be of sharks, or other predaceous fish, torn from their jaws by the struggling prey, are sufficient to record the ferocious instincts of the ancient predatory tribes. In the Mansfeld slates thousands of fish, with scarce a scale displaced, may still (apparently) present in their contorted frames, the agonies in which their existences were terminated. The tree or plant may be yet erect—or its prostrate stem, or broken gnarly boughs may be eaten through and through by the sea-wood-worm (teredo)*—the one grew where it stands, the other, drifted over the wide ocean, speaks in its riddled substance, in silent eloquence of its wanderings.

He who carefully notes the position of the fossil, who records faithfully where it was found and how, is no mere collector; depend upon it he knows something still more of the value of a fossil.

One cannot begin everywhere at once, so something must be taken for granted. Among those things I must put upon the faith of the reader, are first, that this world is of very great antiquity; millions, many thousands of millions—even myriads—of years old. And yet that it shall not be altogether on trust, we will draw again on one or two common fossils for just evidence enough to show that the strata are not of diluvial origin, but that time was taken to form them.

What do we see on our own shores where dead shells lie exposed on the surface of the mud? that worms (serpulæ,) zoophytes, sponges, algæ, and parasites of all descriptions encrust them with a little community of life.



Lign 8. Valve of Fossil oyster from the white chalk (of Dover,) with young oyster attached to the internal surface.

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* The "ship-worm" of the present seas.

We figure a shell from the white chalk, one valve of an oyster with another smaller one attached to the internal surface. The first oyster must have lived and died, its animal substance must have been decomposed, or have been eaten out by the scavengers of the deep, ere the second could have attached itself to the *inner surface* of its valve, and this smaller one must have lived and grown from its almost microscopic state of fry to the size of the second oyster probably of two years' growth—for the oysters of the chalk are small and thin. Suppose this: then it must have taken more than two years before the slowly-falling sediments of the Cretaceous Sea had accumulated to the extent of a few stout sheets of paper. Now the ordinary aggregate thickness of the three associated chalks, upper and lower white, and grey, is not much less than a thousand feet, and all this mass was formed at no greater maximum rate. The fossil shells and fish we find imbedded in its strata, of course lived and died in its waters—they were living-beings in those remote days. So self-evident does this fact seem,—although it was once stoutly discussed—that I have not dwelt upon it, nor shall I, as any doubts on this point will be swept away in the natural progress of our remarks. And yet the chalk is itself but a portion of the Cretaceous group or system of rocks, and that system but one amongst many systems formed at no quicker rate.

(To be continued.)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Late Mortality amongst distinguished Geologists—Action of Water on Plutonic Rocks—Artificial Production of Minerals; Aragonite formed in Steam Engines; Rubies and Sapphires—Oscillation of the North and South Coasts of France—The Sand of the Desert of Sahara—The Coryphodon—Newly discovered Foot-prints of Extinct Animals—Researches on the Flora of the Tertiary Formations.

Before entering upon the regular correspondence with which we hope to entertain our readers each successive month, by making known to them every new and important geological fact as it comes to light in our part of the scientific world, we think it will not be without interest at the present moment, to cast a rapid glance over some of the later and more remarkable geological observations made on the continent during the year which has just brought itself to a close.

It is with deep regret we must, in the first instance, inform our readers that the past year has been, for the science of geology, one of frequent and almost irreparable losses. One after another the names of some very eminent men have been erased from the list of the living.—While England deplores the death of Hugh Miller, Conybeare, Scoresby, and others whose reputations have not spread so widely, France feels how great is the loss she has just experienced by that of Constant Prévost, Dufrénoy, and D'Orbigny, who have opened more than one new and enlightened path in the obscure branches of their favourite science, and whose meritorious lives have not failed to excite a general admiration. Belgium has lost the eminent Dumont whose classifications of the Belgian strata and admirable geological maps have rendered his name immortal, and American science still mourns for the young and intrepid Dr. Kane, whose hazardous voyages of discovery and explorations of the Arctic Seas, have spread his fame far and wide. Germany has likewise suffered by the death of Dr. Lichtenstein, the learned director of the Geological Museum at Berlin, and the unrelenting hand of death, or rather, the accursed knife of a savage barbarian, has taken away from us the young and indefatigable African traveller, Dr. Vogel.

At one of the last meetings of the Congress of German Naturalists, it was proposed that an enormous erratic block of granite, measuring some six yards high, and from fifty to sixty yards in circumference, should be transformed into a monument to honour and perpetuate the memory of the illustrious Leopold Von Buch. The Congress received the proposition with acclamations of delight and immediately charged two of its members to superintend the operation. The eminent men whose names we have just mentioned, do they not, one and all, deserve also their block of granite?

In our idea nothing can be more interesting, and, at the same time, more important to geological science, than accurate investigation as to the manner in which minerals and rocks are formed and destroyed by nature.—Since the well known experiments of Sir James Hall, who transformed chalk into granular or saccharoïd limestone in a heated and hermetically closed gun barrel, many philosophers have attempted to produce in their laboratories, the mineral productions found in nature. These attempts have been attended, in many cases, with perfect success, and the list, already rather considerable, of artificially formed minerals, is daily increasing.

Whilst M. Daubrée has been calling the attention of the Academy of Sciences to the rapidity and ease with which the Feldspar rocks undergo decomposition by the action of water, M. Becquerel has investigated the action of pressure and high temperatures in the production of artificial minerals.—Every one has remarked the prodigious action which water exercises upon minerals in general, but, however paradoxical the assertion may appear, nowhere can this action be rendered more palpable than when it is brought to bear upon the plutonic or eruptive rocks, such as basalt, granite, protogine, feldspar, &c., which, from their massive structure and hardness, would rather seem to be completely indestructible by an agent apparently so harmless as water. But these rocks contain, all of them, an alkaline silicate, soluble in water, and it is the separation and dissolution of this silicate that determines the decomposition and disaggregation of the rock. If we take, for instance, a piece of hard basalt, and grind it down in presence of water, the species of paste which is thus formed, presents, in a very short time, an alkaline reaction, rendered evident by test paper.—M. Daubrée has made a like experiment on a larger scale. He places in a barrel full of water, to which a movement of rotation is given, small fragments of quartz and feldspar. In a few hours the water contained in the barrel is found to have dissolved a considerable quantity of alkaline silicate.

M. Becquerel in order to obtain some idea of the chemical actions that have taken place in the sedimentary strata, at the time they were covered over, uplifted, and heated by the eruptive rocks, such as granite, porphyry, basalt, &c., has minutely studied the influence of pressure and heat acting simultaneously upon different bodies whilst these bodies enter into chemical combination with one another. Nothing could be more simple than his mode of operating : Taking a thick glass tube, closed at one end, he places in it the substances intended to act upon each other, *i. e.*, to produce the combination he desires. To procure a great pressure, he makes use of highly volatile substances, such as ether or bisulphide of carbon which he adds to the contents of the tube. The latter is then hermetically sealed and placed in an oven, to which, at will, a certain degree of heat (generally from 100 to 150 degrees centi-grade) can be given. In some cases Becquerel has added the action of a weak electric current to that exercised by heat and pressure in the experiments.

By operating in this manner he has lately obtained Malachite or carbonate of copper, exactly imitating the natural species ; sulphide of silver, and Galena or sulphide of lead, have been obtained crystallised in thin laminæ. Some beautiful samples of sulphide of copper were also produced in six-sided prisms, bearing the same angles and modifications, as those produced by nature herself. Protoxide of copper was obtained in fine octahedrons, and Aragonite or dimorphous carbonate of lime, in straight rectangular prisms so large as to permit an easy estimation of their angles.

Before quitting the subject of Becquerel's experiments we would refer to an interesting fact, viz. : the formation of the last-named mineral species, in steam engines. The concretions formed in boilers of steam engines have been found, in cases where the incrustations were composed of carbonate of lime, to be almost always of that remarkable variety called Aragonite, distinguishable from the common carbonate or Iceland spar, not only by its prismatic crystals, but also by their hardness which enables them to scratch those of the ordinary calcareous spar. It would seem from the foregoing observations, and from those formerly made by Gustav Rose, in *Poggendorff's Annales,* that wherever carbonate of lime is precipitated at a high temperature, and under a certain degree of pressure, we have production of Aragonite.

M. Gaudin has likewise been very successful of late in the production of artificial minerals. He has given us a recipe for making sapphires in a few minutes, with hardly any trouble and at an extremely small expense. We know that the precious stones *Corindon*, *Ruby*, *Sapphire*, &c., are essentially formed of pure alumina, colored by very minute quantities of certain substances, the nature of which has not yet been perfectly determined. M. Gaudin, some time ago, obtained artificial rubies by melting alumina with a very small quantity of chromate of potash, but the process was rather a difficult one. He has lately made known an easier method by which he obtained an infinite number of minute crystals of alumina; these crystals were found to be, for the most part, transparent hexagonal tables, amongst which were seen smaller ones, quite red, and of a rhomboidal form. Most of them were exceedingly minute, and their forms could only be thoroughly examined by the aid of a microscope, but, since then crystals large enough to serve as pivots in watches, &c., have been obtained. The experiment just referred to furnishes us with another incontestable proof that the hard mineral substances presented to us in nature under crystalized forms, have been produced by the agency of heat, and have certainly not been deposited from water, as the crystals produced in our laboratories, from solutions, or like the beautiful calcareous spar which is forming every day under our eyes, in the grottos of limestone districts.

M. Tessier on presenting to the Paris Academy of Sciences, last October, a piece of petrified wood from a submerged forest on the west of Normandy, spoke of an interesting geological phenomenon which is taking place daily on the French coasts. It appears from his statements, that whilst the MediterraneanSea is slowly retiring from the south coast of France, rendering these shores yearly broader and broader by the new made land or muddy deposits it is leaving behind, the North Sea, on the contrary, is forcing its way slowly but surely on the north-western coasts, gradually encroaching more and more upon the continent, and penetrating, in some places, to a considerable distance, into the neighbouring dry land. That this phenomenon has been at work for some time is proved by the fact that the ancient lighthouse of Boulogne, elevated during the reign of Caligula, and which was still standing in the fifteenth century, has since disappeared and is now nowhere to be seen; the sea has long ago swept it away, and hidden beneath its waves the spot upon which it stood. We have numerous examples in geology of this encroachment and retiring of the sea on or from the coasts of different continents, and we shall doubtless have frequent occasion to refer to them in some of our future articles. The uplifting of certain banks of shells, the sinking or lowering of monuments erected near the sea coast, procure us ample grounds for investigating the effects and causes of these phenomena; and the slow oscillatory movements noticed on the coasts of Sweden, Norway, Sicily, Sardinia, Italy, New Holland, certain parts of America, &c., as well as the periodic, although irregularly alternating rise and fall of the water in the Caspian and Dead Seas, together with like phenomena already observed in the Coral Seas, show us, that without earthquakes, properly so called, the surface of the earth is capable of the same gentle and progressive oscillations as those which must have prevailed so generally in the earliest ages. One of the most curious oscillations of maritime shores, is that which, according to Belpaire, is going on at the present time along the coast of Flanders. If we are to believe the eminent naturalist just named, the Flemish coast, from the mouth of the river Scheld to the town of Calais, is undergoing a species of oscillation, the axis of which motion appears to be situated near the little town of Nieuport. The land which extends from Nieuport to the coast of Holland, appears to be gradually sinking, whilst the coast line from Nieuport to Calais seems to rise slowly out of the sea. The extent of this oscillatory motion has not yet been determined with certitude.—"The eastern "coast of the Scandinavian peninsula," says Humboldt, (*) "has "probably risen about 320 feet in 8,000 years. In 12,000 years, if "the movement be regular, parts of the bottom of the sea which "lie nearest the shores, and are in the present day covered by "nearly fifty fathoms of water, will come to the surface, and con- "stitute dry land. But what are such intervals of time, compared "to the length of the geognostic periods revealed to us in the "stratified series of formations, and in the world of extinct and "varying organisms!" We may add with the same illustrious

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(*) Cosmos, vol. 1, p. 302, *Eng. Trans.* by Otto.

author that the phenomena to which we have just alluded remind us of the instability of the present order of things, and the changes to which the outlines and configurations of continents are probably still subject at long intervals of time.

Our distinguished friend, Dr. Van den Corput, during a recent travel in Africa, has paid particular attention to the sand of the great Desert of Sahara. The samples he has examined were collected from the north-easterly regions of the great desert, which covers a tract of land of about 300,000 square leagues, *i.e.*, a superficies nearly three times that of the Mediterranean.* This sand is so white and of so fine a grain, that one could easily mistake it for pulverized glass. — Ehrenberg once professed the opinion that the sand of Sahara was chiefly formed of the remains of hosts of microscopic animalculi, resembling those discovered in the calcareous formations on both shores of the Nile.—Van den Corput assures us that this opinion, to say the least, is extremely exaggerated. In the microscopical investigations to which he submitted the sand of Sahara he discovered neither Infusoria, Foraminifera, or Diatomaceæ, and very few, if any, organic or calcareous remains. It appears formed, on the contrary, of extremely minute particles of pure quartz, having an irregular form and very sharp angles. The dimensions of the grains are much less than those of other similar deposits: Thus, whilst the grains of sand from the coast of the North Sea measure from 4-1000ths to 12-1000ths, and those of the tertiary beds, 8, 16, and 24-1000ths, the grains of sand from the great desert measure only from 1-1000th to 4-1000ths of an inch.—The author of these observations considers the Sahara sand as belonging to one of the most recent tertiary formations.

We will now turn our attention for a while to Palæontology.—It is not long since, that Professor Owen, from the examination of a single bone, or rather of a double tooth belonging to the lower jaw of an unknown animal, was bold enough to create a new genus of extinct pachyderms to which he gave the name of Coryphodon, —the tooth resembled somewhat that of a Tapir. The eminent palæontologist, M. Hébert, has since fully confirmed the generic distinction so sagaciously established by the illustrious English zoologist : Not only is the new genus Coryphodon now perfectly established as such, but everything tends to prove that future researches will result in the discovery of intermediate forms, or genera of animals which are now wanting to fill up the gap existing between the genera Coryphodon and Lophiodon. M. Hébert has completed the entire dental system of the former, by the study of ninety teeth found in a more or less perfect state of preservation. Of these the canine teeth are more separated from the incisive than in the Tapir; they are strong and very characteristic, resembling those of no other known animal living or fossil. It is now almost certain that there exist two species of Coryphodon : the first, called by Professor Owen, Coryphodon Eocenus, being more than twice as large as the second species, which M. Hébert has named Coryphodon Owenii. The latter of these two species was certainly a larger animal than the Indian Tapir, the former must therefore have been a most prodigious beast.

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* Compare Humboldt: Views of Nature, Bohn's edition, 1850, p. 89.

Whereas, in some instances, fossil remains and structures of organised beings are found perfectly preserved, even in their minutest details, in others the animal or plant has left nothing behind save a faint impression of its tissues, engraven on the hard sandstone or argillaceous rock whilst still in a soft state ; one of the earliest discoveries of these impressions was made in Saxony, near Hildburghausen, by M. Kaup who found them on the surface of some slabs of variegated sandstone belonging to the Trias formation. M. Kaup and Alexander Von Humboldt regarded them as impressions of the feet of certain Mammalia to which the name Cheiratherium was given. This was rather a startling assertion, as no remains of Mammalia had ever been found in more ancient strata than the Tertiary.—Professor Owen, however, is of opinion that the foot prints in question were made by gigantic Batrachians.—Humboldt made known this important discovery to the Paris Academy of Sciences on the 17th of August, 1835. Shortly afterwards numerous tridactyle markings were observed in the Valley of the Connecticut, but these appeared to have been produced by biped animals, and were doubtless impressions left on the soft mud of the Trias by certain varieties of extinct birds, whereas the former were positively the marks of quadrupeds—whether Mammalia or not remains to be learnt. M.

Daubrée has just drawn our attention to a similar interesting discovery, which he has recently made in France. At Saint Valbert, between Plombières and Luxenil, there are some large quarries of Trias sandstone (variegated sandstone). It was in these quarries that the geologist we have just named, had the good luck to meet with impressions of the feet of quadrupeds in every respect similar to those formerly discovered at Hildburghausen, in Saxony. Underneath the thick strata of red sandstone, which is extracted for building, paving, &c., there exist thin layers of another sandstone, also of a reddish colour, but spotted with green, and alternating with layers of clay which show a like coloration. It was in these clay stratifications that M. Daubrée discovered the impressions we speak of: they were found on the surface of the beds of clay, where they join the superposed sandstone. No doubt exists as to the identity of the animal to which we owe these imprints in France, with the quadruped that produced them on the Trias formation in Saxony. At the side of the footprints of the larger feet were found also some much smaller, having only four toes, and reminding one of the feet of the Batrachian tribe. Not only the form of the feet, but the minutest details of the skin of the foot, are brought to light by a careful inspection of the foot-marks. After having thoroughly studied these and modelled, for the sake of comparison, some impressions of the feet of bears, kangaroos, crocodiles, lizards, &c.* M. Daubrée comes to the conclusion that the quadruped who has left these traces behind him in the Trias formation of Saint Valbert, must have belonged to the class of Mammalia. For our part, we feel more disposed however to adhere to Professor Owen's opinion alluded to above, at least until we shall have more evidence to the contrary than can be furnished by a mere foot-print.

The impressions left by animals who flourished on our planet in the earlier ages of the globe, teach us however some important geological lessons: They attest, in the first place, that the ground over which the animal walked was soft and damp, but nevertheless above water. But these sedimentary strata upon which the animal made his promenades, has since been covered by another deposit, which has actually moulded itself upon the impression of the footprints left behind; and then again by another deposit of the same nature as the first, which can only have been deposited from the sea.* Therefore the ground of which we speak, must first of all have been lifted above the water, that terrestrial animals could have walked upon it; it must then have sunk down again beneath the sea to receive the sedimentary deposits it reveals, and lastly, must have been uplifted again to attain the position in which we see it at the present day.

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* These impressions were moulded in earth of the Trias formation, in which the ancient footmarks were found.

These phenomena which are revealed to us by the study of the formations of bygone ages, are therefore intimately connected with those oscillatory motions of the soil which we observe now-a-days on the sea-coasts in many parts of the world, and to which we have already had occasion to allude.

We will close our short *exposé* by a glance at the Flora of the Tertiary periods, to which our attention has been recently called by the appearance of two admirable works† by the distinguished Professor Goeppert, of Breslau. In these works the learned author does not confine himself to the description of the fossil plants found in the tertiary beds of Schlossnitz and those of the Island of Java only; he moreover compares those with the whole known Flora of the tertiary formations in general, of which the different plants already amount to two thousand species.—This is also the first time that the fossil flora of tropical regions, situated far from Europe, have been compared with the tertiary flora of our own latitudes.

The principal families of which representatives have been found by Professor Goeppert in the Schlossnitz strata are as follows:—Corylaceæ, of which there are twenty-eight species; Calicacæ, nineteen; Betulaceæ, eighteen; Ulmaceæ, eleven; Pinaceæ, six; Papillionaceæ, six; Aceraceæ, seven; Rosaceæ, four; Juglandaceæ, three; Combretaceæ, two; &c.—Professor Agassiz once remarked, if we are not mistaken, that no representatives of the family of Rosaceæ had ever been found fossil; it would appear from his statements that these most useful plants, amongst which we find the apple, the pear, the medlar, the strawberry, the peach, the apricot, the almond, the plum, &c., &c., only made their appearance on the globe with the advent of man. We see, however, by the above, that four species of the *Rosaceæ* family have been detected in the Schlossnitz Tertiary by Professor Goeppert.

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* This is rendered evident by the remains of marine shells, &c.

† Die Tertiere Flora von Schlossnitz in 4to Leipzig 1855; and Die Tertiere Flora auf der Insel Java, in 4to Elberfeld, 1857.

For the materials upon which Professor Goeppert has worked to form his tertiary flora of Java, he is indebted to M. Junghuhn, the ingenious naturalist to whom we owe a detailed description of the geology of this interesting island, published in Dutch and German.—The fossils of Java appear to belong to the Eocene period, *i.e.*, to the oldest Tertiary beds. A singular circumstance immediately strikes us as we examine these fossils; the petrified trunks of trees that have been brought to light in the tertiary formations of Java are, without exception, Dicotyledonous plants, whilst the forests that flourish at the present time on the island are composed of palms and arborescent ferns. However we must not attach too great an importance to this fact, for, the other fossils, *i.e.*, those not petrified, found in these regions, seem to imply that it is merely an accidental occurrence.

The number of species collected by M. Junghuhn amounts only to thirty-nine, amongst which we find: six Palms, five Lauracea, five Celastraeæ, three Magnoliaceæ, three Coryloceæ (all belonging to the genus Quercus), three Pipraceæ, two plants of the genus Ficus, two Apocynaceæ, two Rhamnaceæ; of the Musaceæ, Malpighiaceæ, Zingiberaceæ, Cornaceæ, and Ebenacæ, each one; we have also a species of Fungus, and three doubtful genera.

This small collection however is sufficient to rivet our attention on two striking facts: 1st. The plants of which it is composed are all new; 2nd. The families to which they belong still abound in Java. The vegetative system of this island has therefore not changed since the tertiary periods—which is contrary to what we observe in Europe—the whole of the species discovered as yet and a few genera only, are alone found to be different.

REVIEW.

MEMORIALS, Scientific and Literary, of ANDREW CROSSE, the Electrician.
London—Longman and Co., 1857.

The writer of this judicious and unpretending work is the widow of the now celebrated gentleman, whose biography she has so judiciously penned. "Honour be to those, to whom Honour is due!"

Mrs. Crosse deserves the thanks of the reading, intelligent public, for the honest, modest book she has offered to the memory of her deceased husband.

It is not our intention to enter into the history of Mr. Crosse's school exploits, his early taste for electricity and chemistry, his lightning-catching apparatus, or his dissection of thunder-clouds. Our aim in the pages of this journal will be rather to recommend good books, than to forestall them by extracts. We shall therefore merely point out certain Geological bearings developed by the Electrician's experiments, and leave our readers to study the work for themselves.

Mr. Crosse was famous for the use he made of the electric current in the processes of crystallization. From his Voltaic Battery he produced "Two hundred varieties of minerals"—Sulphides of Lead, Iron, Copper, Silver, and Antimony, with many other compounds, made their appearance in his magic forge; also "Quartz and Chalcedony, with Carbonate of Strontia, Barytes and Lead."

This part of the subject must ever be most interesting to the Geologist and Mineralogist. What problems may not these discoveries of the Electrician unfold, if legitimately applied to the question of Mineral Veins, and the much-argued history of Slaty Cleavage. Heat, we know, is developed by electricity, when the free passage of that power is impeded, and, surely it may have an enormous effect, while thus impeded, in changing the position of atoms, in segregation, compression, and dilatation. The GALVANIC BATTERY is far more likely to give the Geologist the clue to the history of Cleavage than the compression of mud layers in a tin case or a deal box. The development of the little mite "Acarus Crossii," by electricity, caused a wonderful sensation some years ago, and we can remember when Mr. Crosse was taunted as "Atheist," "an impious philosopher," the "disturber of the peace of families," aud, "a reviler of our holy religion." After a time, the true revilers learned that there was no foundation for their attacks upon a character they could not appreciate, and, in justice, they should make themselves acquainted with the history of that good man, who was "neither an Atheist, nor a Materialist, nor a self-imagined Creator, but an humble and lowly reverencer of that great Being of whose laws his accusers seemed to have so lost sight."

Men, who write tirades on subjects of which they are utterly and grossly ignorant, would do well to learn a lesson from the Life and Memorials of Andrew Crosse.

THE GEOLOGIST.

FEBRUARY, 1858.

Contributions to the Geology of Gloucestershire, intended chiefly for the use of Students. By the Rev. P. B. Brodie, M.A., F.G.S., *Vice-President of the Warwickshire Naturalists' Field Club, and Honorary Secretary and Honorary Geological Curator of the Warwickshire Natural History Society.*

We think it may prove useful and interesting to the geological student if, from time to time, we give a brief sketch of the Geology of some of the more famous localities in England, adding directions where to go, and how to work—which, to say the least, will be a great saving of time and labour, and enable those who are anxious to visit rich and instructive fields of research to make the most of perhaps only a brief holiday—a matter of no little moment in these days of almost unceasing toil.

The lovers of nature who live in the smoky atmosphere of great towns, shut up day after day in a close counting-house, enjoy a ramble amongst new or favourite haunts all the more on this account; and it matters not whether they are naturalists, geologists, artists, or merely admirers of the picturesque--the relish for their particular hobby is more keenly felt because it can be rarely indulged in, even if many difficulties stand in the way.

Few persons who have a scientific turn have unlimited time and means at their disposal; and, therefore, to the majority in such a case it is of some consequence to see as much as they can, and take the shortest route to their destination. The rapid and comparatively cheap means of transit afforded by the railway is equally available both for business and pleasure; but where science is the object, it is not always easy in a new country to find out the best and most productive places, and a few hints from any one who knows them well are invaluable.

With these introductory remarks, we proceed at once to the more immediate object of this paper. There is no county in the British Isles where the Geology is so varied or interesting as Gloucestershire, associated as it is with diversified and beautiful scenery which would render it attractive to the mere casual observer. When it is recollected that many different Formations, from the Middle Oolite down to the lower Silurian system inclusive, can be studied with comparative ease, and a good suite of fossils collected from each stratum, the geologist will at once perceive the richness and extent of such a series, and the wide field of observation opened out before him. These different geological groups comprise a very extensive mass of rocks of vast bulk and thickness, of great value for economical purposes, and contain a distinct and variable fauna, which gives us an insight into the earth's history in past times, from one of the earliest ages up to a much more recent period.

The neighbourhood of Cirencester is undoubtedly the best for examining the upper portion of the Lower Oolite, the only member of the Middle being the Oxford clay, which has yielded an instructive set of fossils, and includes a band which appears to represent the Kelloways rock. The geological student will do well to devote a few days to the Cornbrash, Forest Marble, and Bradford clay, in connection with the Great Oolite, which may be reached within an easy distance of the town, and form the chief geological features of interest there. Though the Cornbrash is a comparatively thin bed, it makes a valuable soil to the agriculturist, and also yields a rich harvest of organic remains to the palæontologist. These consist chiefly of marine shells, some of which are peculiar to this Formation, while others occur also in the Inferior Oolite, and may be met with in the quarries near Cirencester, and also on the road to Fairford and Cricklade. Among the Brachiopoda there are several species of Terebratulæ, and among the Echinodermata several forms of urchins, which are highly characteristic. The most instructive section may be seen at Kemble, on the line of the Great Western railway, where the Cornbrash, Forest Marble, Bradford clay, and Great Oolite are all present *in situ*, and exhibit an instructive fault, the Cornbrash on one side of it being brought down to a level with the Great Oolite on the other.

Next to the Cornbrash the Forest Marble is the most important Formation in this district, which, although occupying hereabouts probably a larger area than the former, and, with its associated clay, thicker than the Cornbrash, is equally rich in fossils, and the thicker calcareous beds are of some value for economical purposes. There are several quarries opened in the neighbourhood of the Agricultural College, where many pretty specimens may be obtained. Of course the student will pay a visit to the excellent museum of the College, for which so much has been done by its present geological professor, Professor Buckman, and if he goes there *first*, he will observe what are the most characteristic fossils found in the Formations under review, and will very likely be able to procure many of them. In places, the Forest Marble contains traces of land plants, besides marine shells and corals, in which respect it resembles the Stonesfield slate, as also in its lithological structure. Many of the slabs quarried are very large, and are strongly ripple-marked, and, like similar strata deposited in shallow water, are frequently covered with worm tracks, and other curious markings not necessarily of organic origin.

Near Fairford, in an argillaceous stratum, probably connected with the Forest Marble,* numerous species of beautiful corals have been discovered, but the locality has been kept secret, and few collectors are acquainted with it. This, we think, is to be regretted; it is a sort of close-borough system, which should never be permitted among men of science, and we are satisfied that a liberal spirit, both in making known interesting localities for rare specimens, and a readiness to lend them when required, is the real mark of the philosopher, and most conducive to the interests of science.

The Bradford clay, which does not always accompany the Great Oolite in its range, is well displayed on the line of the Great Western railway near the Ackman-street station; and, although not exceeding seven feet in thickness, is loaded with fossils, upwards of 200 species having been collected by Professor Buckman from this spot. Most of these are present in the Great Oolite also, but a few, perhaps, may be peculiar to it. One of its most striking organisms—the beautiful Apiocrinite, or pear-shaped Encrinite, does not occur here, though it occurs abundantly in the same stratum at Bradford, in Wiltshire; but there are plenty of pretty shells and corals to repay the collector.

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* Or, perhaps, the Cornbrash.

We should now recommend him to take the train to the station nearest to Sapperton Tunnel, as this will enable him to examine the Fuller's Earth which was cut through during the excavations for the tunnel, and which may still be seen on the spoil banks adjacent. We have not said much at present about two very important formations which lie between the Bradford clay and the Fuller's Earth, viz., the Great Oolite and Stonesfield slate, because we propose to dwell more in detail upon them when we describe the district in Gloucestershire where they are most largely developed, and can be studied with most advantage. As the Bradford clay is intimately connected with the Great Oolite, so is the Fuller's Earth with the Inferior; the majority of the fossils prevailing in the Oolite below, and a few passing upwards into that above. It is very rarely that the argillaceous band appears *in situ,* its presence being only indicated (like the upper lias), especially on some of the higher escarpments of the Cotswolds, by the soft, wet nature of the ground, and the bursting out of copious springs. A few fossils, chiefly shells, have been obtained at Cubberly, near Cheltenham; but Sapperton is the richest locality. Its thickness in this district averages from thirty to seventy feet, and the most abundant fossils are Modiola, Ostrea, and Terebratulæ. From this point the student should make the best of his way to Minchinhampton Common, where the Great Oolite has been long quarried, and from whence some of the finest and most beautiful of its fossils have been obtained. We should advise him by all means to pay a visit to the valuable and instructive collection made by Mr. Lycett at that village, to whom palæontologists are indebted for the discovery and investigation of many new forms of marine animal life (chiefly mollusks) which inhabited the sea during this portion of the Oolitic period.* Abundant and varied as these remains are, it is a remarkable fact that there are no traces of any higher order of animals, either terrestrial, fluviatile, or marine, which would seem to imply that land was far distant, although the sea was probably a shallow one and liable to strong and varying currents. The thickness of the whole of the Great Oolite in the district under review does not exceed 140 feet, the upper portion consisting of several beds of hard limestone and marl, containing the remnants, as it were, of a marine fauna, which abounds in genera and species, both univalves and bivalves, in the lower division of this Formation. This latter forms the shelly oolite, locally denominated "planking," and constitutes the upper building stone, which is extremely rich in sea-shells, especially univalves, which here occur in great diversity, size, and abundance. Indeed, there is no other part of England where the Great Oolite is so prolific in fossils of this kind; and though much patience and skill are often required in extracting them, the labour is well repaid, and many a choice specimen added to the cabinet. The Geology of this neighbourhood is extremely interesting in other respects, from the striking physical features which it presents, owing to the numerous breaks which occur in the continuity of the strata, which not only expose many important sections of the strata, but also give rise to the picturesque and beautiful scenery for which this part of Gloucestershire is so justly celebrated. The vales of Brimscomb, Woodchester, Stroud, and Rodborough may be mentioned as among the most striking and attractive. In order to become well acquainted with the geological details of this part of the country, a longer residence would of course be required, and would be always remembered with pleasure; but those whose time is limited must be satisfied with a visit to Minchinhampton Common, and a walk through the valley of Rodborough, all of which may be accomplished in the course of a long summer's day. This is one among the many advantages of Geological pursuits, that it affords healthful exercise for the body as well as food for the mind, so that it has a twofold advantage in this respect. There are probably few geologists who have not a keen appreciation of the beauties of nature, as well as of the wonders of creation. We strongly recommend a walk, hammer in hand, over the breezy Cotswolds; and if perchance, the student should have a day there with the Cotswold Club, he would obtain much assistance from the practical scientific knowledge which its working members possess of the county of which they may be justly proud.

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* The majority of these are described and figured by Messrs. Lycett and Morris, in the "Memoirs of the Palæontographical Society," Part III., 1850, and Part IV., 1853.

We might have said a great deal more about the Great Oolite and its remarkable fossil contents; but, as our object is to aid the student by as simple an exposition of facts as the nature of the subject will permit, and to point out the most interesting localities over a widely-extended area, we must not dwell too long upon any one of these, but pass on to others equally instructive. The upper division of the Great Oolite may be seen again to the east of Cheltenham, capping the higher ground, especially near Burford, Northleach, &c. In some respects it differs lithologically from the same Formation on Minchinhampton Common, and it is thicker in its extension eastwards. The top strata usually consist of beds of marl, which are more or less fossiliferous; and the lower of white limestones, which are extensively quarried near Sherborne Park, above Burford: and, according to Mr. Hull, these limestones contain more fossils at a quarry where the Oxford and Shilton roads join, than anywhere else. Near Andoversford, about seven or eight miles east of Cheltenham, many fossils may also be procured in beds of rubbly, white Oolite. The usual fossils are shells and corals, belonging, however, to comparatively few genera, and presenting in this respect a strong contrast to the Great Oolite on the south.

The Forest Marble appears at Coln Rogers and near Aldsworth, about six miles south-east of Northleach, as well as near Burford, and the Cornbrash also near Shilton. We merely, however, mention this in case the student should like to compare them with their equivalents near Cirencester; for it often happens that even within a very few miles the divisions and sub-divisions of any given Formation present striking lithological differences—certain beds coming in, and others thinning out, which it is always necessary to note carefully, and which can only be done by a minute and accurate examination of every available section, and a close comparison of the zoological contents of each stratum.*

There is another and very important member of the Great Oolite with which it is intimately connected, and of which it forms an integral part, viz., the Stonesfield slate, to which we must now turn our attention. It forms the lower division of this Formation, and consists of a coarse, brown, fissile, ragstone, sometimes sandy and slaty, or passing into a shelly, oolitic freestone; and these characters are very variable over a considerable area in the Cotswolds. Formerly, there were several quarries worked at Sevenhampton Common, five miles east of Cheltenham, and are even now well worth a visit. The ragstone, which is a more compact slaty stone, often blue in the centre, is there overlaid by a few inches of clay, which contains many small shells, among which a small species of oyster (*O. accuminata*) is particularly prevalent. The ragstone is thirteen feet, and the very fissile slate, about five feet thick, immediately underlies it. The neighbourhood, however, of Naunton, Eyeford, and Temple Guiting affords the best sections, and numerous quarries are in constant work—as many as 120,000 slates being obtained during the season. At Northleach the slate becomes an oolitic freestone, mainly composed of small shells, more or less comminuted. This portion of the Great Oolite occupies a considerable extent in the eastern district of the Cotswolds, and may also be noticed at Notgrove, Miserden, and on the descent from Minchinhampton to Brimscomb. Lithologically and zoologically it is identical with the slate at Stonesfield, in Oxfordshire, which has long been famous for its organic remains; indeed, it may be distinctly traced, with few interruptions, from Sevenhampton to Stonesfield. The slate itself, like the Minchinhampton Oolite, is extremely valuable for architectural purposes, and forms a good and useful building stone. The young geologist, however, can see far more of it in Gloucestershire, where many sections are exposed at the surface; while in Oxfordshire, it is worked underground, and the workings are reached by means of a shaft.

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* We advise the student to get Mr. Hull's valuable and interesting memoir on "The Geology of the Country round Cheltenham," published by the Geological Survey, price 2s. 6d., where detailed sections are given, with copious lists of fossils, and ample details of every spot worth visiting.

To the palæontologist the Stonesfield slate is particularly interesting, from the abundance and variety of its fossil contents; for here we have, for the first time in the oolitic group, the relics of Mammalia and land saurians, though occurring again at a much later interval, higher up, in the Purbeck and Wealden at the close of the system. The Lower Oolite group in the Cotswold Hills contains, as we have seen, little else but an assemblage of marine shells, which attest the condition of the ocean at that epoch. The Stonesfield slate, on the other hand, affords a remarkable exception—for shells are not very numerous, the characteristic fossils being land plants, and relics of fish and saurians, terrestrial and marine, chiefly bones, teeth, and jaws. Parts of Insects, wing covers, and bodies of beetles, and wings of dragon-flies, which doubtless formed the prey of the insectivorous Mammals of the period, are not unfrequently associated with the above. Hitherto, no traces of Mammalia have been met with in Gloucestershire, but it is by no means improbable that they will be hereafter detected. A few jaws only of small opossum-like animals of this class have been discovered in Oxfordshire, but it is quite possible that other and larger genera flourished in that part of the country which formed the then existing land. These were accompanied by a gigantic carnivorous reptile, the Megalosaurus, which roamed at large amongst the tropical Palms, Zamia and Cycas, which constituted a portion of the oolitic flora.

Another singular flying lizard, called the Pterodactyl, uniting in itself the characters of several distinct groups, appears to have abounded at the same time.

The common fossils are the remains of land plants, which occur more or less throughout the slate, fronds of ferns and small fruits being the most prevalent. The shells associated with the above are entirely marine, and usually exist only in the form of casts. Two new beautiful species of Star-fish have been met with, the largest belonging to the recent genus Solaster. The latter is a single specimen, and was obtained by Lord Ducie from the quarries at Windrush, in whose collection it now is. He also possesses an entire fossil fish from the same place, the first one, in a perfect state, ever found in the Gloucestershire oolites.

We have dwelt longer upon the fossil contents of the Stonesfield slate, because it affords a clearer insight into the geological history of its Formation, and the terrestrial conditions which prevailed. They were clearly very different to those of the higher zone which succeeded it, and yet, throughout the whole, the changes were often marked and variable—indicated not only by the lithological structure of the stone, but also by the character of the fossils.

We think the student must be interested in the details given above, and we are sure that a careful examination of the whole of the district, the geological features of which have been thus imperfectly described, will amply repay any time or labour spent upon it.

We hope, in our next article, to resume the subject, and to give a brief account of the Inferior Oolite and Lias in their turn.

[Since writing the above, Mr. Lycett's monograph on "The Cotteswold Hills"* has appeared, and the student would do well to obtain a copy, as it gives him a most complete and admirable account of the country referred to in this paper, especially the southern part of it, with which Mr. Lycett is well acquainted.]

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* Piper and Stephenson, price 5s.

On the Geology of the Beaufort and Ebbw Vale District of the South Wales Coal-field. *By* GEORGE PHILLIPS BEVAN, Esq., M.D., F.G.S.

WITH the exception of the very able memoirs drawn out by Sir H. de la Beche, in the "Geological Survey," Vol. I, and the sections of the same survey, as compiled by Mr. David Williams, no coal-field has been so little described or worked out as that of the South Wales basin. Although the work of a master geologist, yet the very nature of these memoirs, describing the general arrangements of the rocks in the south-west of England, altogether precludes any attempt at minute geology, which, indeed, should mostly be supplied by local workers. Other coal-fields have been ably and intimately described, but this particular field only in very general terms. Why it should be so I know not, unless it is that only of late years its vast resources have been opened up, and that its many romantic vallies, teeming with beauty above and brimful of coal and mine beneath, have been made accessible either to the tourist or the mining adventurer. Every year, however, sees new railways opened in Monmouthshire and Glamorganshire; and I have little doubt but that the completion of that magnificent work, the Crumlin viaduct, has done more than anything else to attract persons to that part of South Wales, either from a love of the beautiful, or the scientific interest attached to it. For the study of practical geology in its several aspects, this coal-field possesses many advantages, particularly in physical geology and the peculiar manner in which sections are obtained, owing to the nature of the ground. In the important branch of palæontology, also, it is by no means deficient; for, at least in this district, plants of the coal, as well as shells, fresh water and marine fish-remains have been discovered most abundantly. I propose, therefore, to give a brief sketch of this portion of the field, feeling assured that it is by local and minute investigation that the truths of the first great principles are upheld, and any new difficulties solved. The greatest length of the South Wales coal-basin is from east to west, extending from Pontypool to Kidwelly, a distance of about seventy miles, while the greatest breadth is about twenty-five miles from Merthyr or Hirwain to Cardiff. In this measurement I have excluded the Pembrokeshire coal-field, as both differing a good deal from the other in arrangement of beds and quality of coal, and separated from it by a considerable interval of old red sandstone.

The basin is bounded on the north, east, and west by a pretty uniform belt of millstone grit and mountain limestone, and on the south by a rather intricate interlacement of old red, mountain limestone, permian, and lias. The greatest depth is stated to be near Neath, where the lowest strata are 700 fathoms below the outcrop of the upper ones in the hilly districts. The physical features are pretty much the same throughout the country, although the quality of coal varies exceedingly, it being on the Monmouthshire or north-east side of a good coking kind, while below Merthyr, and in the Glamorganshire vallies, it has taken the character of stone coal. The coal in the Aberdare valley has been taken in large quantities down to Cardiff, as being of the best and cleanest kind for the use of the steamers. Having furnished this general outline, let us look more closely at this district in particular. Like all the rest of the field, the country is here divided into a great many narrow parallel vallies, which run from the north belt of limestone towards the sea, and are separated from each other by long mountain ridges. If we ascend one of these ridges, say the Doman Vawr, between Ebbw Vale and Nantyglo, we shall see as fine an example of physical geology and beautiful scenery as can be well imagined. To the north is extended the dreary table-land of millstone grit, succeeded by the limestone escarpments of the Llangynider range; while, beyond them, are the old red sandstone mountains of the Daren and Penallt Mawr, from whence, in heavy prominence, stands out the isolated mass of grit and limestone of Pen Cerrig Calch. To the east are seen the outlines of the Sugar Loaf and Skyrrid, capped by their old red conglomerates, while in the interval between them are the far distant peaks of the Plutonic Malverns. To the west, peering over their humbler neighbours, are the Breconshire Beacons (2,862 feet), keeping grim watch over the old town of Brecon and the Vale of Usk, while still to the west the eye can trace the same bold outlines of the northern border running into Carmarthenshire. To the south glistens the Bristol Channel, backed up by the faint Mendips and the Devonian coasts of Minehead and Ilfracombe; while, from east to west, appear ridge after ridge of Pennant sandstone like waves of a large sea, only distinguishable from each other by the alternations of light and shade and the masses of smoke from the vallies, telling of the enormous population on the surface, and the inexhaustible wealth below.

As a good introduction to the coal-field, the pedestrian geologist can scarcely do better than start from Abergavenny, a tolerably-sized town on the Newport and Hereford Railway. He there finds himself in a valley of old red sandstone, looking up the Vale of Usk. To the north of the valley is a line of mountains capped with old red conglomerates, as the Sugar Loaf and Skyrrid, from under which creep out here and there an abundant development of cornstones and brownstones; and, although but few of the fishes of that period have been discovered there, there is little doubt that they are as abundant as in the neighbouring county of Herefordshire. This Vale, like the parallel vallies in the coal-field, shows the enormous powers of the denuding force, which has scooped out the softer marls, leaving the harder conglomerates untouched.

To the south the eye glances along the line of escarpment of the carboniferous limestone, which, rising up from Pontypool, makes a rather sudden turn, of which the Blorenge Mountain forms the corner-stone, and runs tolerably due west. Near to Carmarthen the observer will see, during his walk along this range, several utilitarian signs, such as an inclined plane or the shaft of a pit, indicating the approach to a manufacturing district. About four miles from Abergavenny, the road suddenly leaves the Vale of Usk to enter the north limestone gorge of the Clydach. In this valley are situated the Llanelly ironworks, flanked on each side by steep hills, along the north side of which the road gradually ascends for another four miles.

The thickness of limestone at Llanelly and Llangattock, on the Mynydd Pengwern, is about 520 feet, and is of good quality, being much worked to supply the farmers. The lowest beds are the purest, and best for agricultural and smelting purposes. There are frequent sections to be met with along the whole line of country; the nearest to the Llanelly quarries are those of the Trefil, of enormous size, and worked in terraces, from whence the stone is brought to supply the Ebbw Vale works. The junction of the millstone grit with the limestone is well seen here, as boulders of grit frequently roll over the summit and mingle with the *débris* below; indeed, in a small cavern to the east of the quarry the walls are of limestone, while the roof is of grit. This cavern was turned to good account by some blacksmiths at the time of the Chartist insurrection, in 1839, and used as a place for making pikes and other weapons. The following is the section displayed here, which I have obtained, with some others, through the kindness of Mr. Adams, the resident manager of the above works. It occupies about 450 feet:—

Light grey limestone.
Dark grey do.
Light do. do.
Brownish coloured limestone.
Calcareous shale or marl, containing shells.
Dark coloured limestone.
Light blue do.
Light grey do.
Light blue do.
Dark do. do.
Calcareous shale.
White limestone.
Grey do.
Light blue do.
Calcareous marl.
Dark Blue limestone.
Light blue do.
Dark blue do.
Light grey do.
Dark grey do.
Calcareous shale.
Light grey limestone.
Grey do.
Calcareous shale.
Dark coloured limestone.
Grey do.

These rocks are tolerably prolific in fossils (principally in the calcareous shales) although not in very good preservation—viz., productus comoides, spirifer, terebratula, euomphalus, phanerotinus, lithodendron, zaphrentis, and other corals. The walk up the valley, following the bed of the Clydach, is, for those who prefer the scenery to the limestone sections, of the most romantic description—the waterfalls, especially that of the Pwl-y-cwm, will alone repay the pedestrian for his trouble. Having arrived at the head of the valley, a short walk over the intervening millstone grit lands us at Brynmawr. The grit occupies a large area of table mountain, and is as boggy and unproductive as most millstone grits. It consists, in some places, of a quartzose conglomerate, and in others of coarse sandstone, glittering with mica.

I append a section of the grit, or, as it is locally termed, Farewell Rock, an expressive name given by the collier, although, as will be seen, it is not quite destitute of coal seams occasionally :—

SECTION OF 80 YARDS.

Sandstone.
Strong white sandstone.
Sandstone and argillaceous shale.
Sandstone.
Argillaceous shale.
Coal, four inches.
Sandstones and shale beds.
Coal, one foot six inches.
Blue Sandstone.
Brown do.
* Argillaceous shale, with small pins of Ironstone containing shells.
Strong grey sandstone.
Dark do. and argillaceous shale.
Dark grey sandstone.
Argillaceous shale.
Dark grey sandstone.
Light brown do.
Conglomerate, or plum-pudding stone.

Brynmawr is a large mining town, with a population of about 8,000, which has sprung up as a feeder to the important works of Nantyglo and Beaufort. It is placed very near the outcrop of the coal measures, and at the head of one of the parallel vallies which I mentioned before. The guardian hills on each side are composed of Pennant grit or sandstone, which is usually considered as a middle series, separating the upper from the lower coal measures. These rocks attain a great thickness, and are characterised by a thin roofing sandstone, in form and appearance very like the hollybush sandstone at Malvern, but covered with minute carbonaceous specks. The beds are stratified very regularly, with but a slight dip, and present small and confused traces of vegetation. According to Sir Henry de la Beche they were found in the following manner :—He considers the principal mass of sand to have been forced along the bottom by the pressure and movement of super-incumbent water, but

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* To this layer I shall afterwards more particularly allude.

little having been thrown down in plane horizontal surfaces from mechanical suspension in the water. It is a kind of deposit, which, if the sand be readily supplied, may be effected in very shallow water, and hence, by continued subsidence, a very great thickness may be eventually obtained. The Pennant rocks are not abundant in coal seams in this portion of the basin, but at the Town Hill, at Swansea, according to Mr. Logan, there are at least twelve veins in these sandstones, which there attain the thickness of 2,125 feet. Indeed, the only seam at Ebbw Vale is the Troed-y-rhiw coal, two feet four inches thick. Locally, the small veins found in the rocks above the coal, as also those found in the millstone grit, are termed Rosser Veins.

I propose, in another paper, to describe the veritable coal seams, with their fossil contents.

On Fish Remains in the Yorkshire Coal Field, near Wakefield. *Communicated by* G. W.

The disposition of the coal measures is pretty generally known by most persons who have paid any attention to the science of Geology.

It will not, therefore, be necessary for me to describe their position or the place they occupy; undoubtedly they are of very ancient origin, being nearly allied to the old red sandstone, amongst which some of the fossils, or rather similar fossils, have been found, which I am about to describe.

Hugh Miller is the great authority regarding the old red sandstone deposits; no man laboured here with more assiduity than he, and it is my regret that I have not, as yet, informed myself more as to his labours. His recent posthumous work, the "Testimony of the Rocks," alludes to some fish remains which Scotland has produced; but Professor Agassiz is still more eminent as it regards this interesting class of fossils.

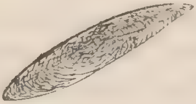
I said interesting, for I had no conception that fish remains could have been rendered so remarkable, and this may be owing to the delicate and soft nature of the mud in which they have been laid. I cannot imagine that my readers should be so captivated with these remains as myself, for there is a peculiar interest felt by all those who conduce to any new discovery; and the more any science is studied the more fascinating it becomes, particularly if we have been led into it by an intimate knowledge of its mysteries from actual observation. Having had no guide amid some of the labyrinths in which I found myself involved, I have been led to mark my footsteps more carefully and studiously, and it is only by such careful procedure that we may expect to arrive at any satisfactory conclusions.

In the year 1839 Mr. Teale, an eminent surgeon and naturalist of Leeds, read a paper before the Yorkshire Geological and Polytechnic Society on the identification of strata by the remains of fish contained in the carboniferous system of the Yorkshire coal fields. He concluded that the Middleton bed, about five miles from Wakefield, was not identical with the Lofhouse Seam, but that a thin band of imperfect coal was identical with the Halifax beds, and he came to this conclusion because they both contained a bivalve shell of the Pecten character. He endeavoured to stimulate geologists and coal-owners to a further examination of the fish coal strata, but I do not find that any further discoveries have been made since that period, with the exception of what I am about to relate.

It may be thought by some that I am going to establish some little renown for my own observations, but facts may be allowed publicity in a matter which concerns the geologist and naturalist. About the period, or perhaps a little before the time Mr. Teale read his paper to the Society, my attention had been led to a pit near Stanley, about a mile or more from Wakefield, near to which I found, on the embankment formed by the material thrown up in sinking the shaft, some indications of the fish structure, and was so fortunate as to find a scale or two and a tooth: from the small amount of material through which the shaft had been sunk, I was unable to collect much, but a few small specimens of bone were added to my scanty stock. My attention was, however, I may say happily directed this year to the similarity of material previously found to a more considerable portion thrown up and exposed to the day in the construction of the Leeds, Wakefield, and Bradford railway, and on further examination I found certain indications of fish remains; but I had then no idea of the field now opened, or about to be opened to view. In my first attempt this year I was gratified in finding some scales of fish of a very minute character, with numerous bivalve fresh-water shells of the unio genus; I had not proceeded far, however, before I found new specimens of scales which I had never before seen, and it was not long before I enumerated scales of several distinct characters, some finely enamelled, and fish-teeth of three or four different kinds. After a few weeks' labour in this (to me) interesting field of research I obtained a jaw of a minute fish, very perfect, with six or seven teeth attached, and also a fine portion of a large jaw with three large teeth, which specimens were exhibited by my friend, Mr. Tootal, at a late gathering of the Yorkshire Natural History Society, at the hospitable mansion of Edward Wood, Esq., at Richmond, in this county, and there excited considerable interest.

The bed containing these fossils is exposed to view about a mile and-a-half to the north of the town of Wakefield, and is found dipping to the south-east in the direction of Stanley and St. John's Church; in all probability it underlies the whole town, and possibly continues for many miles in extent. The thickness of the true coal immediate is only four or five inches, and it underlies the bed containing the organic remains, which bed is composed of a hard kind of splintery dark shale combined with a mixture of imperfect coal shale in layers, which easily yield to the hammer. It must be understood that the bed is of two kinds, one wherein the fracture is brittle and uncertain, the other where the cleavage occurs in layers of a more certain and determinate character, and yields easily to a blow given; the two combined are about two feet in thickness. Both above and below the beds is found the usual bind of a soapy texture, so common in the coal measures, and of a whitish or grey leaden colour. The probability is, that at some earlier period of this earth's history, the bed alluded to was a deposit from some fresh-water lake, analogous, it may be, to some of the American lakes, wherein have sported a variety of fish chiefly of the Ganoid order. The scales of many exceed an inch square, and are covered with a fine-coated enamel, with very minute pores—for instance, the Megalicthys Hibbertii; others exhibit a rotundity of shape (the Holoptychius Giganteus) with beautiful markings on the under surface, which the softness of the bed and the extreme fineness of its composition tend greatly to preserve—so much so, that they will repay examination from the powers of the microscope, a feature somewhat remarkable and unusual. The teeth are of several different kinds, some small, others from a half to one inch or more in length; they are of a bright glossy texture, and some of them curved and striated.

It may, indeed it must be, difficult to describe these fossils in a way at all satisfactory in a notice of this kind, and would seem to merit a fuller description hereafter.* It may, however, be remarked that the first of the scales under notice appears of an elongated form, resembling in shape a small leaf of about an inch in length by one-sixth or one-fourth of an inch wide; its markings are, however, very singular and beautiful. The sketch of it herewith may tend to give some idea of its shape, but the general features and minute cellular structure are wanting. I am led to suppose that this scale must be classed with the Ganoids, although much thinner in its structure than scales of this class generally are. My reason for this conclusion is that it is not serrated at the edges, a distinction which Professor Agassiz makes in reference to fish scales of the Placoids. In fact, I find that nearly all those which are found in my collection assimilate much more to the forms and species of the old red sandstone formation, so far as I have been able to trace them in his voluminous work.



The more my researches into this subject have extended, the more incapable I appear to myself to do anything like justice in the elucidation of the structure of the scales and other remains of these extinct fish. In fact, it would appear to me to require more space and time than I have already given to the subject, fully to detail any one specimen. So convinced do I feel of this fact, that I have almost considered it advisable to begin *de novo*, or relinquish it altogether; but as my remarks, however desultory, may tend to aid some future adventurer, and may serve as a pioneer or guide to those who reside in the coal districts, I cannot relinquish the attempt; and, having entered on a somewhat new and untrodden path, future discoverers will make ample allowance for the difficulties which at present I may have to contend with.

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* A more definite description, accompanied with woodcuts, will be supplemented in a future number.

If it be true, as Emmerson suggests, that there is nothing in the material world but what has its affinity in the region of mind, or which has its relation to the imaginative part of the rational creation, then may I infer that I was led to a search for these fossils by an intuitive instinct, for certainly there was little outward indication to lead me on. If anything in nature could be hidden, this was an instance of the kind; for when exposed to the gaze of some around me, the truth of the discovery was even then doubted, and it was only by a constant reference to them, and further investigation, that I could assure my friends of the importance due to it: but subsequent and more important objects attained, did not fail to convince the more incredulous.

The carboniferous matter in which these fossils are found has tended very much to preserve them in their entirety: the impressions are, in fact, the fossils; the scales themselves appear to possess much of their original composition, so do the bones—they are bones and scales still, and not petrifactions; and if I were asked to account for this, I should attribute it to that remarkable property which carbonaceous matter seems to have; for instance, we read of the bodies of men having been found in peat bogs and morasses many years after life had become extinct, not having undergone putrefaction.

The teeth seem to claim more attention than I have been able to give in this imperfect detail; but there is one of so remarkable a character as to merit further notice. I allude to the one before me; its appearance and shape somewhat resemble the human hand when closed; the jaw may represent the back of the hand; the teeth, the knuckles and fingers—in fact, it is more of a jaw than teeth; but the teeth and jaw are as much one and the same as the hand and fingers; a tooth will bear extraction in general, but in this instance they are inseparable, as much so as the hand and fingers.

The formation of the scales in these fishes seems to originate from a central axis developing afterwards into numerous cells, which appears to be the case in all animal and vegetable structure. Some of them, as in the macrocephalus, lock into each other at the edges; others again not only appear to radiate from a centre, but have also a ligament in the part from which the scale takes its rise, and is very observable in nearly all of the fossils of the holoptychius, and others for which we have at present no name.

It may be remarked by some that "the scales certainly are very interesting objects, as also other portions of the fish; but we should like to see some representation of the complete fish." We reply, that no perfect specimen has yet been found, or any near approximation to a perfect fish or reptile, in this locality; but we know this, that comparative anatomy is now so far advanced that, with the jaws and teeth, a true representation may be obtained. These we have, and it only rests with the comparative anatomist to decipher the whole. It is no slight gain in these discoveries to furnish the requisites for a more complete elucidation.

In conclusion, we see that in the course of time another race of beings is found to occupy the site of one that is past; and who can tell but that the railroads of this kingdom, which have proved the means of disinterring these and other organic remains, may be one day again submerged, and that fishes may once more luxuriate over the now verdant plains of England? It may be supposed that the race of man will never become extinct so long as the world exists, but we know not

> "Thro' what new scenes and *changes* we must pass:
> The wide unbounded prospect lies before us;"

the future we cannot trace. We do not infer that any new race of creatures will at some future time expatiate on the remains which man may have left on record of his existence on the face of this globe. The importance of mind, with its endowments, bespeaks a change from an earthly character to one more spiritual and refined, so that in all probability we are fast hastening to the last stage of the drama; and that what has been earthly and sensual will become ethereal and spiritual. The physiological condition of this planet indicates that man, like the inferior creatures around him, has passed the subordinate stages of animal existence, clothed with beauty as many of those scenes undoubtedly were in the history of the past; still, the present like to it, is only an inferior condition of his being, the embryo of his existence, the threshold of the future. He looks upon the past as one scene of imperfect organism with all its wonderful development, and this wonder enhances his curiosity to know what is still awaiting him; he finds himself tied to earth and its laws, as it regards his corporeal existence, but he longs to soar beyond the present, and attain to that future good which the Creator has dimly shadowed forth in the pages of Revelation.

THE COMMON FOSSILS OF THE BRITISH ROCKS.

By S. J. Mackie, Esq., F.G.S., F.S.A., &c., &c.

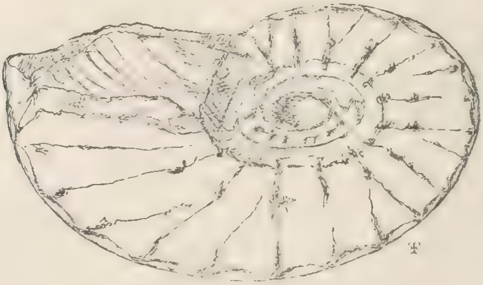
CHAPTER I.

The nature of Fossils and their value.

(*Continued from page 29.*)

More things remain to be spoken of fossils; wonders of skill to be presented in their construction and design; marvels of mechanical devices for progression, for strength, for lightness, or for protection to be displayed; and consummate wisdom and benevolent forethought to be exhibited in their adaptation to the various purposes for which they were created—in fact, as much as we find to admire or to consider in the structure of existing animals or plants, in their means of developement or of growth, in the influences of climate and seasons upon them, so much also do we find for equal admiration and reflection in those ancient "medals" of past creations.

Even contorted and damaged fossils are not without their evidences.



Lign 9.—Ammonites varians, from the chalk marl of Dover, distorted by pressure.

Squeezed on either side or flattened, they do not merely indicate the pressure to which they have been subjected, but the direction also from which it came. Everything connected with fossils is of high interest; but from first to last the value of fossils is in their teachings; and it is never by pounds, shillings, and pence that we can value them at all. In such a light they are but worthless bits of stone, as fit to mend the roads as to be saved. To minds that esteem them thus, they are no treasures, but merely merchandise. Properly studied, however, they convey their lessons of the past; and when regarded as letters in the vast and holy book of Nature, which must ever be read with solemnity and reverence, they take their places properly in the great sentences and wonderful passages of that mysterious language from which Geology interprets the order, wisdom, goodness, and prescience displayed in the animated worlds that were. It is thus we shall have attained to the true knowledge of the value of fossils, when we shall turn from such readings with adoration to the Great Author of all.

CHAPTER II.

The Rocks—their order and their teachings.

"Put off thy shoes from thy feet, for the ground on which thou standest is holy." And the ground on which *we* stand *is* holy. Holy in its venerable age, and with the impress of Divinity; and when with solemn reverence we approach the consideration of its eventful history, and the skilfulness of its design, are we less in the presence of God than was the Lawgiver of old standing, with another purpose, before the burning bush? There is a time for all things—to be gay and to be solemn; and there will be occasions for a lighter style than we think fit in this place to pen our thoughts. We design not to treat of the value of the rocks nor of their uses, but to draw from them some of those heart-felt lessons which rank amongst the highest efforts and best results of the grand science of the earth.

We begin with the order of the rocks. Is there skill in the construction and organization of our bodies, is there marvellous mystery in the wonderful connection of our corporeal parts with our souls, in the combination of the material with the immaterial, of bodily existence with spiritual existence, of the animate with the inanimate, of senseless matter with the sense-pervaded, sense-pervading, ethereal, and immortal spirit? Is there less of the mysterious and wonderful in the minute but living monad—anything less incomprehensible in the living but mind-deficient plant and tree? Is there not skill and perfection, design, and a *sustaining* hand visible in all around us? And is the great globe orderless and chaotic? No! The hand that fashioned and created, the great mind that planned and endowed with specialities the living creature of a day or of three-score years and ten, has laboured for inconceivable millions of years in the fashioning and perfecting of our world — even the senseless winds and waters seem to have joined in effort with the other more subtle powers in the general progress and elaboration of its structure.

Deep down below, covered by a thousand feet of stone—so modern borings have taught us—are the ancient mountain ridges of the primitive world. Deep down below, in their mysterious plutonism, are the crystalline primordial granites, and stacked above them are the ponderous stony records of the past creations and ages. Deep down below, and far back into time, must the mind by perception penetrate when it begins to study the order of the rocks; and, without inculcating something of the knowledge of the regularity of their succession, and the catastrophes by which that succession has been variously interrupted at particular times and places, how could we hope, when we opened and read from the great historical folios of those creations, which for ever have passed away, that our words would be intelligible or understood?

Much as is known of the rocks themselves, much yet remains to be discovered: there are wide fields yet to be trodden, wide gaps in our investigations yet to be filled up. Theories and systems are after all but the exposition of the existing knowledge of the time, and the prevalent ideas of one age have been deemed to be folly and ignorance in another. Men's inferences may have changed, but the facts remain; and every year is bringing us nearer and nearer to the truth, however far we may be, notwithstanding all our advance, from a full knowledge of all the laws of nature. Those laws have ever been the same, before even the great foundation-stone was laid on which the superstructure of the fossiliferous rocks has since been raised.

All soils or earths—rocks, as they are technically called—are divided into two classes or groups; the one stratified or in layers (strata) and mechanically deposited by water from the degradation or waste of preexisting mineral substances; the other igneous, that is fire-formed or fire-altered, such as volcanic lavas and granite. An intermediate class, the metamorphic, is produced where the former or aqueous beds have been brought into contact with the latter—the heat of the one having changed the characters of the other—in the vicinity of, and often to some considerable distance from, the point of junction. The heat has also destroyed or obliterated, to a greater or less degree, the traces of organized fossils.

I have here to request that, for the present at least, it may be taken for granted that the beds or strata are presented in regular series or succession, containing the remains of ancient animals and plants, which have been of very different characters, at those different periods, or systems, into which the past history of our own planet is divided.

Probably many of my readers will have acquired much of this elementary information from the numerous popular treatises which have been produced by so many of our eminent geologists, although there are still many to whom even these primary tenets of our science will be new. For their sakes, therefore, I repeat that which I know to be familiar to others.

Even those who know the general features of the science will not suffer by a repetition occasionally of the knowledge they have acquired, and as never an artist who sits down to draw an oft-repeated scene produces a fac-simile of his predecessors' works, so the geologist, though he repeats an old tale, still embodies something of his feelings and of himself in the new picture which he paints. The accompanying tables will display the principal divisional arrangements of the various earths or rocks, and will aid the uninitiated reader in following our remarks.

UNSTRATIFIED ROCKS.

Plutonic.		*Volcanic.*
Rocks subjected to heat beneath the surface and not ejected like lava, although often protruded in rugged masses through the disrupted beds of stratified rocks.	Example: Granite.	Rocks the produce of ancient volcanos; often ejected as in modern eruptions. Examples—Basalt, Trap, Lava.

STRATIFIED ROCKS.

Rocks formed by the deposition from water of the sediments derived from pre-existing materials. These are grouped into great divisions called systems, representing periods in time, the rocks thus associated together having a collective relationship. The members of each group, while presenting also some general linking features among themselves, are nevertheless marked by distinctive characters which more or less separate them from each other.

THE ORDER OF THE ROCKS.

		GROUPS.
First Period. **PRIMARY** of authors.	AZOIC—A (Gr.) *without;* Zoe, *life:* from the presumed absence of organic remains.	Oldest sedimentary rocks. Harleck grits, Longmynd flags and schists.
	(The old authors included Granite, Slates, and the multifarious rocks called "Grauwacke," under the term Primary.)	
	PALÆOZOIC—Palaios (Gr.) *old;* Zoe, *life.*	Lower Silurian or Cambrian. Upper Silurian. Devonian. Carboniferous. Permian.
Second Period. **SECONDARY** of authors.	MESOZOIC—Mesos (Gr.) *middle;* Zoe, *life.*	Triassic. Liassic. Oolitic or Jurassic. Wealden. Cretaceous.
Third Period. **TERTIARY** of authors.	CÆNOZOIC—Kainos (Gr.), *new;* Zoe, *life.*	Eocene. Miocene. Lower Pliocene Pleistocene or Upper Pliocene.
Fourth Period. **RECENT.** In part Quarternary of some authors.	Includes all rocks, volcanic or sedimentary, formed since the creation of man.	Gaudaloupe limestone. Modern shell-sandstone. Travertin. Tufa, &c. Vegetable Soils.

(*To be continued.*)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

The Emerald and its green colour—Its analysis and formation—Green Gypsum in the Emerald mines—More artificial minerals—Hyalite, Wollastonite, and Aphophyllite—Quartz, Feldspar, and Pyroxen—Feldspar in the lava of volcanos—Petrifaction and Epigenesis—Spontaneous crystallisation of amorphous bodies—Hardening of rocks by exposure to the air—Extraordinary origin attributed to oolite rocks—Modern oolite discovered by Leopold Von Buch—More Footprints in the Jurassic formations.

One of the most interesting results has just been obtained by a thorough chemical investigation of the emerald. This interesting mineral, which has given rise to so much discussion as to its composition, its formation, its colouring matter, &c., may now be looked upon with still greater interest since the researches of M. Lewy have been made known. The ingenious chemist just named, in a visit to the mine called Muso, in New Grenada, Mexico, was lucky enough to procure some very fine specimens of emeralds, and of the rock in which these precious stones are found. The first thing that struck him, on receiving these specimens from the hands of the miners, was the excessive fragility of the stones: the largest and finest emeralds could be actually reduced to powder by a slight squeezing or rubbing between the fingers.

It is a well-known fact that the ancient inhabitants of this part of America used to judge the value of the emerald by its hardness. So little had they observed the phenomenon of which we speak, that their principal test consisted in striking a hard blow upon the stones as soon as they were extracted from the earth: if they resisted they were considered perfect stones, if not they were thrown aside as valueless articles. M. Bousingault remarks that in this manner, no doubt, a great number of very valuable specimens have, in former times, been destroyed.

A certain space of time and repose are required for these soft emeralds to assume the hardness which renders them valuable as precious stones. The fine specimens destined for the lapidary and the jeweller must be stowed away with the greatest care for a few days. As to the *cause* of this hardening of stones recently extracted from their natural beds we shall have occasion of referring to it presently.

M. Lewy has shown also in his interesting paper (*Researches on the Formation and Composition of Emeralds*),* that the beautiful green colour, so much admired in the stones of which we are speaking, and without which they would, in all probability, be valueless, is owed to an organic substance somewhat similar to that called chlorophylle, which colours the leaves of plants.† The green colour of emeralds has always been attributed to a slight quantity of chromic oxide, which, although it certainly does play an important part in the coloration of other minerals, has positively nothing to do with that of emeralds. Analysis has furnished only an exceedingly slight quantity of chromic oxide; so small, indeed, that the distinguished chemist whose work we are analysing could not weigh it separately. Our readers have, perhaps, heard of, or seen, a mineral called ouwarovite, a sort of chromiferous garnet, whose green colour (which withstands heat, whilst that of the emerald does not) is exactly that of the emerald; but ouwarovite furnishes 23 and-a-half per cent. of oxide of chrome, whereas in emeralds, as we have seen, there is only a slight vestige of this green oxide. This is certainly a new and unexpected result.

A certain number of facts related in his memoir lead M. Lewy to affirm that emeralds have been deposited from water. It would, perhaps, be more rational to say that water has been active in their production ‡—First, besides the organic colouring matter, emeralds contain about 2 per cent. of water. In the next place, the black white-veined limestone in which they are found contains fossil ammonites. This limestone, perfectly freed from the microscopic emeralds with which it is strewed, by digestion with dilute hydrochloric acid, gives in analysis a $\frac{5}{10000}$th part of glucina.

Great uncertainty has prevailed as to the mineral constituents of the emerald and its true chemical formula; this has determined me to give here the numbers obtained by M. Lewy, and to corroborate them by showing, at the same time, the results obtained, some years ago, by M. Moberg, in the analysis of some emeralds from Finland:—

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* Presented to the Academy of Sciences, Nov. 15th, 1857.

† It is, perhaps, as well to observe that M. Lewy has not ascertained if this organic substance in the emerald contains oxygen or not. He seems to consider it as a carburet of hydrogen.

‡ See further, the phenomena recently observed by M. Daubrée.

	Emeralds from Mexico (M. Lewy).	Emeralds from Finland (M. Moberg).
Silica	67·9	67·359
Alumina	17·9	16·465
Glucina	12·4	12·747
Magnesia	0·9	—
Oxide of iron	—	1·49
Soda	0·7	—
Titanic acid	traces	0·28

Both these analyses show that the emerald contains 1 atom of alumina, 1 atom of glucina, and four atoms of silica. In that of M. Lewy slight traces of chromic oxide were weighed with the magnesia, and probably some titanic acid with the alumina. The green colour of the emerald is darker in those specimens which furnish to analysis most organic matter; it is completely destroyed by heat, the stone becoming white and opaque.

On the communication of these results to the Academy, M. Bousingault observed that he also, in former days, had visited the Muso mine, and that he had picked out of the strata in which the emeralds are found, pieces of gypsum of a beautiful green colour, resembling that of the emerald. He had no doubt, from M. Lewy's observations, that the green colouring with which the gypsum was impregnated was identical with that just discovered by M. Lewy in emeralds.

M. Daubrée has furnished us with some new and interesting details concerning the artificial production of minerals. By a close observation of the methods employed by nature, and a certain intrepidity in the laboratory, this enthusiastic geologist has had the good fortune to produce some crystallized specimens of minerals which have never before been purposely formed or accidentally found in scoriæ. He formerly observed in the mineral springs at Plombières, the waters of which contain silicate of potash and soda, and have a temperature of + 70° Centigrade, the formation of certain well-known silicates and other minerals usually found in the veins of eruptive or primitive rocks. Most of these have been formed, since the time of the Romans, in the orifices of the mineral springs in question. An old Roman tap in bronze was found covered with a crust of sulphide of copper which, from its aspect, its crystalline form,[*] and its other properties, it was impossible to distinguish from the Cornwall specimens.

The masonry near the springs was often seen to be impregnated with hyalite (a sort of transparent silica) in every respect similar to the hyalite found in basalt rocks; and sometimes apophyllite (silicate of potash and lime) showed itself in very neat crystals. We would observe here Woehler succeeded formerly in dissolving and crystallizing this mineral by the aid of water at 180° Centigrade.

M. Daubrée asked himself this question: If we find hydrated silicates formed slowly in mineral springs at no very high temperature, is it not probable that anhydrous silicates may be artificially and more quickly produced by the action of water at a higher temperature? Numerous experiments have answered this question in a most affirmative manner. They consisted principally in submitting the different substances in presence of water, to a heat of 400° Centigrade for a month together, in a closed glass tube, enveloped and protected by an iron case.

As glass formed part of the apparatus, it naturally occurred to him to determine first of all, what would be the result of this treatment on glass itself. It was soon found that this substance undergoes, by the simple action of water at this temperature, a complete decomposition: it first becomes opaque, earthy, and fragile, resembling kaolin, then it gradually and regularly swells and transforms itself into a host of minute crystals, which were found on examination to be wollastonite ($3\ Ca\ 0,\ Si\ 0^3$); at the same time the alcalis of the glass, and a certain quantity of silica, are dissolved. Soon, however, silica is deposited in the form of crystallised quartz, of which some of the crystals measure two millimeters in length. The presence of alumina modifies these phenomena; thus, when obsidian was acted upon in like manner, minute crystals of feldspar were obtained, resembling, *en masse*, granular trachyte. Clay and kaolin, which had been previously purified by washing, on being submitted to a similar treatment, gave birth to feldspar, mixed with crystals of quartz; and if the glass, in the first experiment, is decomposed in presence of oxide of iron, not wollastonite, but *pyroxen*, is obtained—the samples of which immediately remind us of the natural crystals found in the Tyrol, Piedmont, at the Somma, &c. They are beautifully crystallised, and possess both their green colour and their usual transparency.

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[*] The natural specimens of sulphide of copper are *dimorphous* with the sulphide of the laboratory.

From these investigations, M. Daubrée feels justified in concluding that a great number of silicates—perhaps all—found in the primitive crystalline rocks, have been formed by the influence of water at a high temperature; which temperature is, however, very inferior to that of the point of fusion of these silicates. He seems to think that the granite rocks themselves very probably owe their formation and crystalline appearance to similar causes. We must content ourselves here by indicating the result of experiment, and be silent as regards discussion. If the experiments just related, and which are being continued by M. Daubrée, are repeated with success, his conclusions will appear certainly very natural. The most striking feature in his paper is, without doubt, the formation, in the above circumstances, of feldspar—a rock so universally spread throughout nature, and which plays so important a part as constituent of almost all the primary or eruptive rocks. Although crystals of feldspar have been discovered in scoriæ, and, by Heine, in the refuse of a furnace for copper fusing,* it appears from Humboldt's statement † that they have never before been purposely formed:—"Nor have chemists," says he, "ever succeeded in artificially producing either feldspar or horneblend." It may be well to add that feldspar is daily formed under our eyes in the lava of volcanos. Since M. Daubrée's observations have come to light, this must doubtless be attributed to the abundant quantity of water incorporated in lava until it becomes completely solidified.

M. Kuhlmann, of Lille, has published a long memoir on siliceous infiltration or petrifaction, and on epigenesis. ‡ In this work the learned author, who has already done so much for the advancement of chemical and geological science, has presented us with nothing very new. He explains the curious phenomenon of petrifaction by the action of carbonic acid, or of carbonate of ammonia, on the silicates of potash and soda invariably found in spring water. A similar theory has been already professed and published by others, and, I believe, by M. Kuhlmann himself.

The phenomenon of petrifaction is certainly one of the most curious processes in nature. Is it not wonderful to find the soft stem of some well-known plant transformed into a hard stone, and yet retaining most of its colour and external appearance? Let us see how this happens. In one of the paragraphs of our last article we had occasion to notice the action of water upon the so-called Plutonic rocks. We have seen that an alcaline silicate is invariably dissolved out of the rock by water. In nature this silicate is carried away by the rain-water to fertilize the earth; it is absorbed with the water by plants, many of which rob it of its silica in an extraordinary manner. Vegetables are known to evolve in the act of respiration, and more especially at night, a certain quantity of carbonic acid. We know also that this acid decomposes silicate of potash or soda, and in a few hours precipitates the silica of these salts. It is in this way that the different *grasses* and the plants of the genus Equisetum, &c., retain in their tissues considerable quantities of silica, especially in the green parts of the epidermis or cuticle, where the function of respiration is most active.* But when a piece of wood undergoes decomposition, and becomes brown and decayed, it also evolves a great quantity of carbonic acid, which acts on the alcaline silicates with which the wood is often imbued by the absorption of spring water, in the way we have just described, and precipitates their silica. In this manner, for every atom of carbonic acid furnished by the carbon of the decaying vegetable, an atom of silica is substituted; so that, after a certain space of time, the entire tissue of the plant is converted into a tissue of hard stone. † Animal substances, such as the bodies of polypes, mollusca, &c., furnish principally carbonate of ammonia by decomposition. This volatile salt acts upon the silicates of potash and soda in the same way as carbonic acid, explaining to us at once the manner in which the petrifaction of shell-fish and other animals takes place.

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* They were analysed by Kersten.

† *Cosmos*, Vol. I.

‡ *Comptes Rendus*, Nov. 9, 1857.

But to return to M. Kuhlman—the most important part of his memoir relates to *epigenic forms* (or the covering over or replacing of one mineral species by another, without change of form). He has eneavoured to demonstrate that whenever, in nature, a chemical decomposition takes place *very slowly*, the products are crystalline, and assume the forms of the pre-existing body;* whenever the decomposition takes place abruptly we obtain, on the contrary, amorphous precipitates or bodies devoid of crystalline structure. Amongst other experiments, M. Kuhlmann has shown that a current of sulphuretted hydrogen transforms many salts of lead into sulphide of lead without producing a change in their structure, thus explaining certain anomalous forms observed in nature. A current of ammonia transforms pyrolusite into protoxide of manganese without producing a change in the form of the crystals of the first. Nascent hydrogen has the same effect whilst reducing certain metallic salts, &c.

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* It is a well-known fact that certain sugar-canes, bamboos, &c., will often strike fire with steel, on account of the large quantity of silica contained in the bark of their stems.

† The colouring matter of the bark of the trees being accompanied by tannic acid and other substances which have the faculty of preventing, in a great degree, putrefaction or decomposition, is often most beautifully preserved in petrified specimens of woods.

The same author has, more recently, made a very interesting study of the spontaneous crystallisation of amorphous bodies. It has no doubt happened to many of our readers to pick up pieces of common flint in which certain parts are profusely crystallised, or studded with minute transparent crystals of quartz. It has been M. Kuhlmann's object to show how these crystals have been formed, and to explain other like phenomena. Numerous observations have shown him that amorphous or earthy matters in general have a great tendency to crystallise by slow desiccation; and he has shown by experiment that, in time, many substances, at first apparently without structure of any sort or kind, will take crystallised forms. This is perfectly illustrated by malate of lead, which, as every chemist knows, is produced in the form of an amorphous precipitate, but which after being allowed to repose for a certain time, shoots out into crystals. M. Kuhlmann has shown that in any substance the crystals produced in this manner are neater, or better defined when the drying has proceeded very slowly.† The siliceous deposits formed at the present time by the geysers of Iceland furnish numerous examples of the spontaneous crystallisation of which we speak.

It has been frequently observed that when a piece of rock, or a mineral, is freshly taken from the quarry, it is often much softer or more fragile than when it has remained some time exposed to the air, as we have already remarked with regard to the emerald. This is very manifest, for instance, in newly-made marble slabs, which, if they are placed against a wall in an inclined position, are apt to bend, and become in a great measure valueless to the owners. After a few days' exposure to the air the rock or mineral becomes hard, losing at the same time a considerable quantity of water. M. Kuhlmann has endeavoured to prove that this hardening of the rock and expulsion of water are not owed to simple evaporation or drying, but to a process of crystallisation which takes place slowly from the moment the rock is exposed to the air.

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* Thus we see sulphate of potash placed in damp chalk, transform itself slowly into gypsum without losing its crystalline form (according to Beudant).

† The same holds true, to a certain extent, for volcanic lava, both ancient and modern, which furnish very different products, according as their cooling has been rapid or slow. In the first case they often form a black non-crystalline glass; in the latter, a stony mass of crystalline structure.

Natural crystals are often found strewed on a rock of their own composition, which rock, in M. Kuhlmann's idea, has given birth to the crystals in question by a species of contraction or slow crystallisation, accompanied by loss of water—phenomena which he has artificially produced with sulphate of baryta, sulphuret of mercury, oxyde of copper, &c. He explains in like manner the origin of the beautiful crystals found in geodes.

M. Virlet D'Aoust, civil engineer, has lately presented to the Academy of Sciences a paper on the eggs of certain aquatic insects found in Mexico, and which he looks upon as the means by which oolitic rocks have been, and are still being, formed. However extraordinary—we might, perhaps, say mysterious—this origin of oolites may appear, we must not be too hasty in rejecting the statements brought forward by the author, whom we believe to be a man of some geological experience, and a clever engineer. Has not Ehrenberg shown that immense masses of the earth's surface owe their origin to a profusion of microscopic infusoria, foraminiferæ, &c.? M. Virlet D'Aoust, in his turn, endeavours to show that oolitic rocks owe their existence to myriads of minute eggs, the seed of some aquatic insects. Here are the facts observed:—

Everyone has heard of the great plain of Mexico, situated some 2,300 meters above the level of the sea. Near the centre of this tract of land are seen two large lakes.* The first, the water of which is fresh, goes by the name of Chalco, the second is a saltwater lake called Texcoco. The observations made by M. Virlet led him to discover that the bottoms of both these lakes are formed by a sort of grey limestone of modern formation, containing small oolites which, in the author's eyes, are in every respect similar to those found in the rocks of the Jura formation. He immediately made known this fact to Mr. Bowring, director of the salt works at Texcoco, who informed him that these oolites were owed simply to the incrustation of the eggs of water insects by the carbonate of lime daily deposited from the waters of the lakes. In a second excursion to the lakes the author remarked that their banks were strewed, under water, with an infinite number of insects eggs, about the size of a pin's head, and which appeared to be those of a new species of boat-fly (Notonecta). The Mexicans consume immense quantities of these eggs at their meals. They are extracted from the water by means of bundles of reeds or grass, on which the insects deposit their eggs by millions at a time. M. Virlet is not only convinced that these modern oolites of Mexico owe their origin to the eggs of a species of boat-fly, but seems to think also that the oolite of the Jura, and other ancient strata, must be attributed to a similar cause. "This explains," says he, "the irregular distribution of oolitic grains in the rocks of the Jurassic strata. Where the oolite is hollow, the egg has been enclosed before being hatched; where the oolitic globules are completely solid, the eggs have had time to hatch, and the cavities left by the exit of the larvæ have been filled up by the incrusting limestone.

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* It was from these large Mexican lakes that Humboldt brought back with him Scheuzher's *antidiluvian man* (*homo diluvii testis*), a large salamander belonging to the most recent freshwater formations.

If these facts are confirmed by future observation, it will not be without interest that we shall recall the Greek origin of the word oolite (Ωον, egg; λιθος, stone). I would, however, on this occasion remind our readers that a small oolitic bed, bearing great resemblance to the Jura limestone, was formerly discovered by Leopold von Buch * near Teguiza in Lancerote—one of the Canary Islands. This oolite bed is also of modern formation, and probably continues increasing at the present time. It would, therefore, be of great geological interest to ascertain if the oolitic deposit made known to us by Leopold von Buch owes its origin to causes similar to those stated by M. Virlet in reference to the Mexican oolite. Such an investigation, which could

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* Canarishe inseln.

be easily made by the English vessels which frequently visit the Canary Islands, would be more likely to decide the important question than the examination of ancient oolites with a view to discover some organic remains that might be attributed to the eggs of insects.

In my last article I mentioned a curious discovery of footprints made by M. Daubrée in the Jurassic formations at St. Valberg. Since then, the celebrated naturalist, M. Paul Gervais, has brought forward some interesting facts of a similar kind. In a short paper addressed to the Academy of Sciences, he describes some footprints of extinct animals found in strata corresponding to those observed by M. Daubrée. The impressions he speaks of have been recently discovered by himself and some friends at Fozière, near Lodève, in the south of France. They were observed on the surface of slabs of sandstone alternating with beds of marl, and are exactly similar to the footmarks found some years ago at Hildbourghausen in Saxony, at St. Valberg in France, and, as M. Paul Gervais remarks, resembling those formerly discovered at Storton-Hill, near Liverpool. The learned author observes, that until further evidence can be furnished as to whether these footprints belong to mammalia or reptiles, he will maintain the opinion of those naturalists who consider them as being owed to large amphibious animals, whose bones and teeth abound in certain parts of the Trias beds. These amphibious reptiles are those which Owen, de Munster, Jaegar, Fitzinger, Hermann Meyer, and other naturalists have described as large Salamanders, Mastodonosauri, Batrachosauri, Labyrinthodonts, &c. Paul Gervais himself, and Hermann Meyer, first made known the remains of these animals in France, in the variegated sandstone near Soultz-les-Bains, (Bas-Rhin), and in the Muschelkalk at Lunéville, and Fleming (Meurthe).

The characters of the footprints observed by Paul Gervais, near Lodève, answer to the form of animal described by Kaup as Chirotherium, or Chirosaurus Barthii. The details given by the author as to the configuration, the strata, and circumstances in which they were found, &c., are precisely identical to those related by M. Daubrée (see our last paper). Like the latter, M. Paul Gervais has observed by the side of the larger marks, others, belonging evidently to some smaller animal, and showing four digital impressions; the author thinks these must be attributed to a species of palmipede. A third species of footprints was likewise observed, consisting of a star-like impression formed by four toes of unequal length, and attributed to an extinct bird known to American naturalists by the name of ornitichnites.

An interesting collection of these footprints has been deposited by the order of M. Paul Gervais in the Geological Gallery of the Faculty of Sciences at Montpellier, where they may be examined at leisure by naturalists visiting that town.

LETTER FROM THE REV. C. KINGSLEY,

RECTOR OF EVERSLEY.

(*To the Editor of the* GEOLOGIST.)

DEAR SIR,—I have read with great pleasure and also great hope, your first number—and am especially delighted to find that you aim at spreading a popular knowledge of Geology. May I, in furtherance of this object, make a suggestion? Why not establish in your magazine a regular geological "Notes and Queries" department?

There are hundreds, if not thousands, who have no time to work out geological problems for themselves; who yet are most desirous of instruction, and would receive the results of the science frankly and trustfully. Artizans desirous of self-instruction, and ladies of rank desirous of instructing their children would, alike, be glad to know a hundred things which, not having books, time, or perhaps scientific habits of mind, they cannot find out for themselves. If a knot of wise men, and such a clergyman as Mr. Brodie among them, would deign to explain to these people their puzzles, they would be doing a noble work, and sowing good seed in many minds which would bear fruit in a future generation, by freeing it from childhood, from the bonds of many superstitions and traditions of altogether human invention.

May I give an instance in which I myself appear in the character of one begging for information?

Last summer, in the Isle of Purbeck, I was told of a wonderful rock, the Haggerstone,* which lay on the top of a hill in the northern moors of the Isle, overlooking Poole Harbour. "Would I go and see it?" For nobody agreed how it got here. "It was a proof of Noah's

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* QUERY.—Hag's Stone; Hexe's Stone; Witches' Stone.

Deluge." "It had been washed up to its present elevation by a flood." "It had been formed" (this I think was the suggestion of a Reverend Brother) "by sands blown up the hill from the mouth of Poole Harbour" ! ! ! and so forth—some of the theories being not much in advance of that of the country folk, "that the devil had dropped it there" (as he is in the habit of dropping boulders in many counties) "during a nightly excursion for the purpose of blocking up Poole Harbour mouth." I went, and found a noble rock indeed—a cube of some twenty feet—on an isolated heather peak looking far and wide over moor and sea, with an old black-cock washing his steel-blue jacket in the sand at its foot.

A glance showed me that it was no boulder, but a remnant of partially-removed tertiary strata, probably still *in situ*, though it might have sunk to a lower level from the abrasion of softer beds beneath.

But (and here my ignorance cries for help) I found that its innumerable strata, and the gravel around, were not composed of the same materials as the Bagshot and New Forest beds, with which I am tolerably acquainted, but of coarse quartz grit, mixed with a dark grit, apparently fragments of trap.

Now will any kind and wise man tell me (1) How they got there? (2) Whether they came from the Dartmoor granites and South Devon traps? (3) Whether they have any connexion with the vast beds of porcelain clay which are spread over the basin of Poole Harbour, a few miles off? One could not help fancying that the soluble silicates of alumina from the disintegrated metamorphic rocks lay below in the deeper basin, while the coarser grit had been washed on to the shores of the æstuary to be upheaved afterwards on the shoulders of the Corfe chalk ridge: but guesses are useless without investigation; and I was leaving the place in a day or two, and did not know but that the whole subject had been worked out already by some wiser man. Am I, therefore, to be debarred from learning at second hand what I had no means of discovering at first hand? And how can I more easily learn than through such a "Notes and Queries" department as I recommend to you?

Conceive hundreds of people having each a question like mine to ask, and a dozen kind-hearted sages who will bear with our ignorance (often I fear with our silliness) and answer, at least, "If you will read such and such a book, you will find out all about it." And you will see that there is plenty of scattered good (for all teaching is good) to be done; and also plenty of possible subscribers to your magazine, when it has taken a shape which will bear on them.

Believe me,
Your thorough well-wisher,
C. KINGSLEY, F.L.S., F.S.A., &c.

[In one of the prospectuses in which THE GEOLOGIST was announced, it was described as "a general gazette of Geology," "a geological 'Notes and Queries;'" and it was with the view of establishing a "Notes and Queries" department, or something equivalent thereto, that students and others who might wish for information were invited to send their questions to the editor of this magazine. We beg leave to call particular attention to this invitation, which will be found repeated this month on the second page of the cover. It is gratifying to find our plan approved by a man so well qualified to give an opinion on the subject as Mr. Kingsley; and we hail his letter and the recommendation it contains with great pleasure. We hope that some one or other of our readers, who may have studied the Geology of the Isle of Purbeck, will have the goodness to reply to the questions propounded by our correspondent. The latter will perceive that we now commence a "Notes and Queries" department which will, we hope, eventually attain much larger dimensions, and will serve effectually the purposes for which it is intended.—ED. OF GEOLOGIST.]

PROCEEDINGS OF THE WARWICKSHIRE NATURALISTS' AND ARCHÆLOGISTS' FIELD CLUB DURING THE PAST SUMMER.

ALTHOUGH this Society has only been established since July, 1854, the number of members now amounts to nearly one hundred, and the meetings have been most agreeable and successful. We think it may interest our readers if we give, from time to time, a short account of the proceedings of the club; and in order to bring it up to the present year, we shall briefly review the labours of the session concluded in October.

The first meeting was held at Chipping Campden, in Gloucestershire, on Tuesday, the 20th of May. A party of fifteen started from Warwick at 8.30, reaching their destination at 11. Here they were joined by only three members of the Cotswold Naturalist's Club, whom the Warwickshire Club hoped to have met in full force, especially in their own county, but unforeseen causes prevented the attendance of the most active labourers in the field, with the exception of their esteemed Hon. Sec., Professor Buckman. The number was increased by the timely arrival of several Warwickshire naturalists, who all proceeded at once to the church, an ancient structure containing many points of interest, but spoilt, as too many country churches are, by galleries and other deformities. After inspecting this, the archæologists proceeded to look over the town and neighbourhood, which occupied them satisfactorily during the afternoon. The geologists and botanists, who mustered in greater strength than usual, went to the spoil banks on the railway, which are the result of the excavations obtained from the Mickleton Tunnel, and which have been long famous for their rare and beautiful fossils. The strata in which they were discovered belong to the top beds of the lower lias, just below the marlstone which is seen cropping out by the side of the banks, on the line, near Mickleton, and on the rising ground adjacent. In the shale and clay below the marlstone are layers of ironstone rich in ore, so much so, that it might be worked with profit; indeed, a similar bed was formerly worked in the same position in the lias at Robinswood Hill, near Gloucester. Associated with it is a bed of sandstone full of organic remains, chiefly marine shells, lying together in masses, in great variety and abundance. The rarer forms obtained at this locality consist of several new species of starfish, ophinra, crustacea, and some echeriodernus, which were first discovered by Mr. Gavey, the intelligent engineer of the line, and have since been figured and described by the late Professor Forbes, in the third Decade of the Geological Survey. In the course of the ramble, Professor Buckman, at the request of the Vice-President of the Warwickshire Club, gave a brief account of the geology of the district; and thus ended a very pleasant and instructive day, which was rendered still more agreeable by the beauty of the scenery and many other points of interest in the neighbourhood. One of the botanists present discovered an extremely rare, if not an entirely new, plant, which will probably be shortly figured and described.

The second summer meeting was held at Dudley, on the 22nd of June. The members assembled at the Hotel at 10, where they were joined by the Worcestershire Naturalist's Field Club, and, under the guidance of Mr. Fletcher, the party proceeded to the far-famed Wren's Nest, and the greater part of the day was spent investigating the many interesting geological features which it presents. It is composed entirely of Wenlock limestone in the upper Silurian series, which here rises up into dome-shaped masses, forming the Castle Hill, Wren's Nest, and other lesser elevations, which have been protruded through the surrounding coal formation by igneous action from below. At Rowby and other places these outbursts of igneous rocks are apparent at the surface, and are formed entirely of trap or basalt, which is extensively used as a road-stone. As may be supposed, the strata are highly inclined, and dip away at steep angles on all sides of the anticlinal. On the summit of the hill the Vice-President (Mr. Brodie), at the request of the party, pointed out the geological features of the district, and briefly alluded to the many curious fossils for which it has been long celebrated. Many of the commoner fossils were picked up by the geologists present, who formed a numerous body on this occasion. The view from the hill was said to be extensive, but a combination of mist and smoke obscured every distant object. Returning by the coal-pits, the members were much interested by seeing the upturned beds of the coal formation, which have been raised to the surface by the upheaval of the Wren's Nest, and dip away from it almost vertically.

The members now reached the Priory and Castle, both of which afford many points of interest to the antiquarian. The morning's ramble closed with an inspection of the celebrated Caverns, which were kindly lighted up by the permission of Lord Ward, who, unsolicited, offered this act of courtesy to the Clubs. The lighting up of these caves, or rather old deserted quarries, had a most striking effect, and was greeted with loud cheers by the numerous body of spectators. The united Clubs afterwards dined together at the hotel, and a few brief scientific disquisitions—in which Dr. Grindrod, Mr. Brodie, Mr. Lees, &c., took part—terminated a very pleasant and interesting excursion. The united Clubs formed a large party, numbering twenty-seven persons, including Mr. Salter, of the Geological Survey.

The third meeting of the season took place at Coventry, on the 11th of August. The members assembled at the King's Head Inn at 11.30, and proceeded to the Wyken Colliery, for the purpose of inspecting a portion of the Warwickshire coal-field. Mr. Whittem, the owner of the pits, here explained the character and extent of the coal-bearing strata in the district, which was clearly illustrated by a section of one of the pits. The party being duly equipped in miners' dresses, went down the shaft with comparative ease and safety, and descended about three hundred feet into the bowels of the earth, under the guidance of Mr. Whittem and the foreman of the pit. Although the examination of the coal *in situ* was attended with considerable labour, those present were amply repaid for the instruction afforded them by a personal inspection of a deposit which is one of the most valuable and important in the world. It is very rarely that the coal itself appears at the surface, as most other formations do, and therefore it can only be seen and worked at a considerable depth underground; and the members of the Field Club were glad to avail themselves of this opportunity of seeing the way in which it was obtained, and the position it occupied with reference to the new red sandstone formation, which it underlies. On their return to the pit's mouth, there was only sufficient time to examine the quality of the ironstone associated with the coal at another pit, and to bestow a hasty look at a large steam-engine used for forcing up the water from below, which was of excellent quality, and of a slightly mineral character.

The Warwickshire coal-field is of limited extent, the principal pits being at Sowe (its south-eastern limit), Wyken, Bedworth, and Nuneaton. It is more or less affected by faults, and a considerable upthrow of trap-rock occurs in one part, where it is extensively quarried, and is similar to that at Hartshill, which is another outburst of the same igneous deposit, and may be traced at intervals as far as Charnwood Forest, in Leicestershire. The quality of the coal is variable, the best being tolerably good. The shale and ironstone associated with it contain the usual carboniferous plants, and, in places, shells belonging to the genera Unio and Mytilus, and an entire and, probably, new species of Limulus, were found at Sowe Colliery some years ago, by the Rev. P. B. Brodie. At Bedworth there is a strong band of fresh-water limestone, containing spirorbis (microconchus) carbonarius, which has also been detected in the Leicestershire, Shropshire, and Lancashire coal-fields. This limestone does not occur at Wyken and Sowe.

A few members who arrived late visited several churches and other places of archæological interest, for which the ancient city of Coventry is famous, and at four o'clock the party, now nearly twenty in number, sat down to dinner. After the usual business of the Society had been transacted, Mr. Whittem, at the request of the President, made a few additional remarks on the coal formation of the district, and Mr. Brodie gave a short account of the discovery of a new and perfect fossil fish in the upper Kenper sandstone, near Warwick. This terminated a very pleasant meeting.

The last meeting of the Club was held on the 15th of September, at Henley in Arden, and was entirely devoted to archæology.

The next meeting was fixed to take place as usual at Warwick, in February next, when the chief business of the Club will be transacted, and places of meeting settled for the year ensuing.

NOTES AND QUERIES.

A Correspondent writes:—"I beg leave to remark that, within this year (1857), several fossil bones have been discovered in the Lias on the beach between this place" (Charmouth) "and Lyme Regis, which, in my humble opinion, go a great way to overturn the general opinion that the Lias contains no fossil remains of Mammalia. I will, at an early period, endeavour to transmit you a sketch of two in my own possession, and two others in that of a gentleman of my acquaintance, who is engaged in pursuits similar to my own. Both of us are zealous collectors—not Geologists, I beg to observe, although we have some specimens which I doubt not would be highly interesting to a professed Geologist."

Neophyte.—A silicate is one of those bodies which are called by chemists "salts." A "salt" is a compound which is the result of the union of an "acid" with a "base." In the case of a silicate the acid which unites with the base is silicic acid or "silica," the material of flints, rock crystal, &c.; and an alcaline silicate is silica in union with an alkali as the base. The silicates of potash and soda (both alkalies) are soluble in water, and thus rocks containing them may be broken up by the action of water, which dissolves the soluble silicate away, causing the other ingredients to fall to pieces.

X. Y. Z.—Algæ are not sponges. They constitute a natural order, consisting of aquatic plants, both marine and freshwater, of which seaweeds are familiar examples. Many of them, especially the freshwater ones, are microscopic objects.—Silt is the fine sediment which is carried down by rivers and deposited on their banks and at their mouths, sometimes in such quantity as to form banks, which block them up, or at least render the navigation intricate and difficult.

Jane E. B.—"Pterichthys" means "a winged fish," and is derived from the Greek words *pteron*, a wing, and *ichthus*, a fish.

O. N. Y.—Woodward's "Recent and Fossil Shells," published by Weale, will answer your purpose.

Verbum Sap.—Your suggestion is useful, and has been under consideration, but there are difficulties in the way of carrying it out. A vocabulary for each number of the Magazine would occupy more room than could be afforded for such a purpose. Most elementary works on Geology contain a glossary of terms; we must content ourselves with giving the meaning and etymology of words when asked for them. Fossils are frequently represented *in situ*, but those which are found in the bed "a confused mass of stems, calices, and arms," as the Woodocrini are described to be, cannot, of course, be drawn in this manner.

T. V. writes as follows:—"To the Editor of the Geologist.—Sir, If any of your readers will give me the names of the localities in the neighbourhood of Durham, that possess interest for Geological students, it will much oblige."

THE GEOLOGIST.

MARCH, 1858.

CONTRIBUTIONS TO THE GEOLOGY OF GLOUCESTERSHIRE.

By the Rev. P. B. Brodie, M.A., F.G.S., &c., &c.

(*Continued from page* 48.)

Having reviewed, in our first paper on this subject, the upper portion of the Lower Oolite, down to the Stonesfield slate inclusive, we propose in this to give some account of the lowest member of this formation, the Inferior Oolite, and then to pass on, in descending order, to the Lias. The district under consideration has, of late years, been very generally and carefully examined by many able and experienced geologists; but nevertheless additions to our knowledge of its Geology are from time to time being made; and our own practical experience in the field confirms the belief often expressed by others, that, however much may have been done in any particular spot, there is always something left to reward intelligence and zea

The student, however, must not be discouraged at being at first able to add but few new facts to the list; he must bear in mind that one truth well authenticated is worth a hundred hasty generalizations and unfounded conclusions. The book of Nature is open to all who choose to read it; and he who, studying it in an honest and earnest spirit, adds something to the stock of general knowledge, even though it should be but a little, yet that little is worth recording, and is deserving of support and encouragement from the scientific public. Without actual reference to the wonderful revelations of Geology, our great poet, Shakespeare, has said, almost prophetically, that there are "sermons in stones, and good in everything;" and, certainly, the geological student may literally adopt this motto. To say nothing of any higher motives, there is a secret satisfaction in the discovery of a new fossil, of a flower, or an insect hitherto unknown; and even he, who does nothing more than follow in the track of greater and wiser intellects, is at least a better man than one who is content to pass through life without effecting anything worthy of recording. With these few prefatory remarks of encouragement to the beginner diffident of his own powers, or alarmed at the difficulties besetting his path, we must pass on to the more immediate purpose of this article.

The Inferior Oolite is so called from its position below all the other oolitic rocks, and in the order of succession was, therefore, the first formed of the group. It constitutes a very important and prominent feature in the physical geology of Gloucestershire; being thicker there than in any other part of England, and yielding to no other portion of the series in zoological interest. In the vicinity of Cheltenham it forms really a great type section; while the changes and modifications which it undergoes in its extensions on the south and east are only such as might be expected to occur in a cotemporary but distant sea-bottom, of which the stratigraphical conditions would vary with the remoteness of the area, and the organic remains of one portion of which would also be only partially identical with those of other portions.

Leckhampton Hill, near Cheltenham, is one of the best places for examining the strata in detail, and we should recommend the student to commence his investigation at that spot. Ascending by the tramway to the lowest portion of the section exposed on the right hand, the basement beds will be found reposing on the clay of the Upper Lias, although the latter is not always visible, on account of the *débris* fallen from above. These "basement beds" are here much reduced in thickness, but elsewhere they are more largely developed; and we shall therefore reserve what we have to say about them until we describe the localities where they are most advantageously exposed. The stratum immediately above them is termed "Pisolite" or pea-grit, and is in many respects a remarkable bed, generally and readily distinguished along the whole line of the outer escarpment of the Cotswolds, from Painswick on the south to Cleeve and Whinchcomb on the north-east. It is usually a hard, coarse, concretionary rock, made up in a greater or less degree of small flat concretions, which give it a singular aspect, and which might be taken for organized bodies by the uninitiated, as they have sometimes small corals attached. It contains a great variety of fossils, often well preserved, consisting of marine shells, corals, and echinoderms; the latter are more numerous, both in genera and individuals, in this bed, than in any other portion of the Inferior Oolite. Among the testacea are some fine and well-preserved Terebratulæ, among which Terebratula simplex and Terebratula plicata may be especially enumerated. The surfaces of the blocks are often covered with corals and shells, with fragments of Pentacrinites and claws of crabs, and deserve a careful scrutiny. The pisolite is 38 feet thick at Leckhampton, and 40 feet at Crickley Hill. It should be observed that many organic remains are peculiar to it, and occur nowhere else in the series.

A remarkable change is to be noted in the overlying stratum, the freestone, both lithologically and zoologically. It is a fine-grained, yellowish oolite, closely resembling that of Bath, a portion of it being good and useful for building. In the upper part there are very few fossils, but the lower portion is almost entirely made up of small shells, in a more or less comminuted state. Nevertheless, by a diligent search, a series of pretty specimens may be obtained at this spot. These broken shells exist also along the western face of the hill towards Crickley. At first sight this stratum appears less rich in specimens than the other divisions of the Inferior Oolite; it has yielded, however, upwards of 160 species of small shells, the bivalves preponderating in number over the univalves. A few species are limited to the freestone, but others range indiscriminately throughout the group. A considerable number agree specifically with forms in the Great Oolite, especially with those of the more shelly beds, in which the marine conditions appear to have been repeated to a certain extent, and which, in other respects, were evidently very similar. This fact is more to be regarded because, as a general rule, the species in the Inferior and Great Oolites are quite distinct, although the genera are for the most part alike. The worn and imperfect condition of the shells shows that the sea in which the freestone was deposited was subject to the movements of frequent and variable currents, which broke up and triturated any organic bodies accumulated therein. In this respect, too, it resembles the Great Oolite. The thickness of the lower freestone is 106 feet. This rock affords a very good example of the oolitic character, the small inorganic oval grains and shelly matter being cemented together by carbonate of lime. The freestone is present in other parts of the Cotswolds; as at Cleeve, Broadway, and

Stanway on the east, in the neighbourhood of Stroud and Painswick on the south, and at Frocesterhill in the same direction, at all of which places it is extensively quarried for economical purposes.

Ascending along the steep path by the tramway to a higher quarry, the full extent of the shelly freestone will be apparent; but here the student will observe that it is divided from a more fragmentary upper band of the same character, to all appearance less fossiliferous, by a cream-coloured marly limestone more or less consolidated, but very different in texture and in organic remains from the freestone. Like the Pisolite below, it forms a well-marked line of demarcation, and may be traced from the most eastern Cotswold extension of the Inferior Oolite to its extreme southern limits, where it thins out and disappears. This oolitic marl contains many fossils along the whole line of the Leckhampton escarpment, especially shells and corals; and, as it is readily acted upon by frost, these may be easily picked out of the matrix. Some of them are distinctive and peculiar, differing from those of any other bed, either in the Great or Inferior Oolite. Univalves are in places abundant, and there are many species of Terebratulæ, of which Terebratula fimbria, with the test or shell preserved of a silvery whiteness, is the most characteristic. At Leckhampton the corals are less abundant than in some other localities, as at Crickley and Pitchcomb, where from their numbers it may be inferred that they formed part of a small coral-reef beneath the oolitic sea. At Miserden, in the vicinity of Stroud, this stratum is very rich in organic remains, especially univalves, including some long and peculiar Nerinææ, and we strongly recommend the collector to visit this spot, as well as Crickley and the quarries at Cleeve, near the "Rising Sun" inn. He will at once recognise this band of marl by its position, its fossils, and its chalky appearance wherever it occurs. If he will now climb to the top of the hill and turn to the left, he will reach several quarries, the strata in which indicate considerable lithological and zoological changes, implying oceanic conditions differing widely from those of the inferior subdivisions of this formation. In Sir R. I. Murchison's "Geology of Cheltenham," edited by Messrs. Buckman and Strickland, these upper beds are locally termed "Trigonia-grit" and "Gryphite-grit," and are underlaid by a brown, rubbly stone, full of well-preserved fossils; above Sandywell Lane the last is charged with a zone of small Terebratulæ. As these upper grits are by no means constant in their presence or in their distinctive characters southwards, often being inseparable, the term "Ragstone" is perhaps a better one for the whole set, the thickness of which would amount to 38 feet. The "Gryphite grit" is a coarse calcareous grit, readily distinguished by the abundance of Gryphæa Buckmanni and G. Cymbium, whence its name. Masses of these shells are piled in heaps, and cannot fail to attract the attention of the geologist, who does not, if he is a careful observer, allow any fact, however apparently trifling, to escape him; as it may help him to read the history of the past, and perhaps may prove to be one of the clues to a correct comprehension of some important fact. Among the numerous fossils associated with these gryphites are occasionally some very large Ammonites, with Ostrea Marshii, Pholadomya, and other fossils, mostly in the form of casts; but at Rodborough Hill, facing Stroud, though much reduced in thickness, the grit is loaded with well-preserved testacea. Palatal teeth of fishes (Acrodus) are occasionally met with there, though scarcely a trace of anything of this kind has been detected in any other of the inferior subdivisions, excepting in the bone-bed at the base of the series at Crickley Hill. As the "Trigonia grit" is not well developed at Leckhampton, and the higher beds are not seen there at all, we must seek them elsewhere, in a southern or north-easterly direction. Thus, at a roadside cutting, called Cold Comfort, five miles south-east of Cheltenham, there is a thin layer of clay and stone dividing the "Gryphite grit" from the "Trigonia grit," abounding in univalve and bivalve shells, which are often entire: it is characterized by the large Perna mytiloides.

Near Naunton and Stowe-on-the-Wold, there is a rough white oolitic stone, forming the highest zone of the Inferior Oolite, loaded with specimens of Clypeus Plotii and Nucleolites clunicularis, with Lima gibbosa and other shells. On the Stow road, at Hampden Farm, beyond Andoversford, the "Trigonia grit" is satisfactorily exhibited, and consists of a coarse, ragged limestone almost made up of Trigonia costata, T. clavellata, Terebratula globata, &c. At Rodborough Hill it is about eight feet thick, and in that district occurs as a hard limestone, more or less sandy or argillaceous, and almost entirely made up of shells. In this part of the series a very pretty shell, Rhynchonella spinosa, is of frequent occurrence; the test is usually retained, and even the long slender spines may now and then be detected. As this fossil never occurs below the "ragstone," it forms a distinguishing mark of the upper zone. In the neighbourhood of Minchinhampton, Mr. Lycett has noticed another and higher stratum, probably the equivalent of the "Clypeus grit" of Mr. Hull, which he designates "Pholadomya grit." Mactra gibbosa occurs in it, and numerous specimens of Terebratula globata. If we include the basement-beds, the total thickness of the Inferior Oolite is not less than 230 feet at Leckhampton Hill; of which, nevertheless, it does not form the main part, as there is a much greater thickness of Lias between its outcrop and the level surface of the plain.* This holds good with regard to the outer edge of the Cotswold chain, in its entire range over a considerable area. On the south and east, the Inferior Oolite is much reduced in thickness, and, as we have shown, subject to considerable variations, both in bulk, structure, and fossil contents; some beds being altogether absent or replaced by others; and, if rich in organic remains at one spot, are entirely destitute of them at another. Notwithstanding the depths and conditions of the sea frequently varied during the period of its deposit, there is one striking similarity in the beds of this division: viz., the almost entire absence of any terrestrial or fluviatile animals or plants. Marine shells and corals of several genera are the prevailing fossils, though remains of fish and saurians have been discovered—the latter very rarely. The student will do well to spend some days at Cheltenham, whence he will be able to make excursions to the chief points of geological interest in the neighbourhood, among which may be mentioned Leckhampton, Crickley, Birdlip, Cold Comfort, Lincover, Cleeve Cloud, Sudeley, and Bredon—all within an easy reach of that town. Further on, in an easterly direction, he may visit the numerous quarries by Andoversford, Naunton, Stow, Stanway, Burford, and Broadway. Southwards he should examine the country in the neighbourhood of Stroud, especially the quarries at Rodborough, Selsby, Painswick, Haresfield, Sheepscombe, and Frocester.

We must now say a few words on a very interesting series of deposits, which we have designated the "Ammonite and Belemnite beds"† ("Cephalopoda-bed" of Wright), which, though much reduced in thickness at Leckhampton, may be studied to advantage at Crickley Hill between Cheltenham and Birdlip, at Haresfield, Frocester, and Nailsworth. Below the "Pisolite" at Crickley is a band of brown, shelly limestone, containing many Ammonites and Belemnites, and a peculiar Terebratula (T. cynocephala), which is highly characteristic of this zone. This limestone has been perforated by boring shells, and minute fragments of bones and teeth of fish are irregularly dispersed through it, so as to form a kind of bone-bed. At Leckhampton, with the intervention only of a few inches of red sandy marl, it reposes on the blue shale of the Upper Lias. At Haresfield and Frocester the basement beds are much thicker and more fossiliferous, and overlie a thick stratum of yellow micaceous sand, from 40 to 60 feet thick, below which the grey marls of the Upper Lias appear. Numerous species of ammonites, belemnites, and other shells, both univalves and bivalves, have been discovered at both these places. The "Ammonite bed" there is a coarse brown oolitic sandstone, more or less ferruginous. Although it would be quite out of place in an article like the present to enlarge upon a disputed point as to the true relations of these beds, it is only right to mention that, while some geologists class them with the Upper Lias, others retain them in the Inferior Oolite. Probably the truth lies between the two opinions, and this stage will be found to be really intermediate. At any rate, for the present it must be left an open question, until we obtain further knowledge of the fossils of these deposits in other districts, and are thus able to weigh the evidence in full, and arrive at exactitude.

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* The entire formation, except where locally affected byfaults, has a gentle dip to the south-east.

† "On the Basement Beds of the Inferior Oolite in Gloucestershire," by the Rev. P. B. Brodie.—*Journal of the Geological Society*, 1851, p. 208.

Viewed from the valley, the outer chain of the Cotswold hills presents a bold line of escarpment, varying in height from 900 to upwards of 1000 feet above the level of the sea. The lower portions present grassy slopes, sinking gently into the plain below, and the upper stand out as bold mural cliffs, for many miles in extent. The hills are often well wooded even to their summits, and their tortuous course from N.E. to S.W. is marked by projecting headlands and deeply-indented bays. There can be no doubt, indeed, that at some remote period the sea occupied this now rich and fertile valley; and there is evidence in certain drift deposits and ancient shingle beaches at various heights along these hills, to show they were once of much less elevation, and washed by the waves of an ancient inland sea, not inaptly termed the Straits of Malvern.

Standing on the top of Leckhampton hill, every one must be struck with the extensive panoramic view, probably unequalled in England, which it commands. The Liassic plain, though flat, is here and there relieved by gentle undulations, and bounded on the west by the fine range of the Malverns, the rounded dome of May Hill, and the hills of the Forest of Dean; while on a clear day a view is obtained of the still more distant mountains of Wales.

There is also another peculiar feature in the physical geography of this district in those outliers or smaller hills which stand out at variable distances from the main chain. These are Robinswood Hill, Churchdown, Battledown, Bredon, and others not distinctly visible from Leckhampton. Though often partially denuded of the oolite, there can be no doubt these isolated spots were formerly united to the Cotswolds, which most probably extended further outwards than they do now.

In addition to Mr. Hull's "Geology of the Country around Cheltenham,"* and Mr. Lycett's "Cotswold Hills," we recommend the perusal of Sir R. I. Murchison's "Geology of Cheltenham," above referred to. Many of the characteristic fossils may be purchased at a moderate rate of Jenkins, a nurseryman, on the right-hand side of the road leading to Leckhampton.

We have necessarily confined our remarks to a limited portion of the geology of a part only of the county of Gloucester; but this must lead us to wider and more general views of the whole subject—local details and discoveries have their chief value in reference to this end—for which reason we would suggest a comparison of the Oolites in their extension into Somersetshire and Dorsetshire on the one hand, and into Northamptonshire, Lincolnshire, and Yorkshire on the other. Geology, in the subjects of which it treats, requires a liberal and comprehensive view to be taken; and valuable undoubtedly as all local knowledge is, we must not rest satisfied with such a limitation, but carry our investigations into surrounding or into distant regions, and study nature on a grand scale, suitable to the wide fields of observation before us.

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* See also Mr. E. Hull's elaborate memoir on the Physical Geography of the Cotteswold Hills, in the Quarterly Journal of the Geological Society, vol. xi., p. 477.—Ed. of Geologist.

A BRIEF DESCRIPTION OF SOME PLACES NEAR KILLARNEY, OUT OF THE BEATEN TRACK OF ORDINARY TOURISTS: WITH REMARKS ON THE IGNEOUS ROCKS OF THE DISTRICT.

By "A Brother of the Hammer."

Reader, have you ever visited the far-famed Lakes of Killarney? If you have not, by all means go there; and if you are a geologist as well as a lover of beautiful scenery, the pleasure of the visit will be greatly enhanced.

There you have lofty and rugged mountains (some of them clothed with wood nearly to the summit), from whose sides gush limpid fountains, increasing in force as they descend, and in their onward course madly leaping down the steep cataracts, until they are at last lost in the majestic lake beneath,—the admixture and variety of the whole being beautifully harmonized and softened by the extraordinarily luxuriant foliage of thousands of plants, from the stately oak, the bushy arbutus, and dark green holly, to the humble but graceful "London Pride" (Saxifraga umbrosa), the abundance of which seldom fails to attract the notice of the most casual observer.

The mountains are formed of rocks of the "old red sandstone period," the upper division of that group or "yellow sandstone" being generally observed at the foot of the slope, this being again overlaid conformably by the "mountain-limestone," which extends in many a contortion over the plain.

In the rocks of the "old red sandstone" a geological eye will at once be struck by the fine examples of glacial action exhibited in the scratches and groovings of their surfaces, caused by the sharp edges of blocks and fragments of other rocks, contained in icebergs, having passed over them; such markings being, for a considerable extent, parallel, or nearly so.

The ordinary visitor to Killarney is generally forced to traverse the same beaten track which hundreds of others have trodden before him. Most people stay for three days only or a week, and during that time are completely at the mercy of hotel-keepers and guides for the disposal of their time; thus losing much both of the picturesque and of the instructive that is gained by the more adventurous tourist. I would therefore point out one or two places, not more than six or seven miles from that place, which few persons visit, and which none should return home without seeing.

To the east of Killarney, at the foot of the cloud-capped Mangerton, there lies a rocky glen called "Glenacappul,"* or the "Horse's Glen." In it are three little mountain-lakes or "tarns," which generally appear as black as ink. The rocks are, the red, green, or grey grits, and slates of the old red sandstone.

On walking down the glen from north to south, the strata are seen bent by numerous contortions, at both the top and bottom of the cliff; but midway, and interstratified with these beds, is a broad band of "igneous rock," the flexures and folds of which are similar to and coincident with those of the former. This igneous rock is a "felspathic trap," or "felstone," and is a compound of felspar and quartz. It is generally of a bluish green or whitish colour, very hard, sometimes containing crystals of white felspar, which, when large and numerous, give it a porphyritic character.

At both the upper and lower surfaces of this band of trap, between it and the sedimentary rock, there are beds of flaky ash, of a green or yellowish green hue.

The massiveness of the rocks, their contortions, the striking appearance of the trap, the stately height of the cliffs, the dark and gloomy waters of the three lakes—all combine in giving an unspeakable grandeur to Glenacappul.

A couple of miles further east, and south of Lough Guitane—a picturesque lake situated on the southern side of the mountain-road leading from Killarney to Glenflesk—is another glen, called Cappagh Glen. Its sides are also lofty and rocky cliffs, and the band of trap interstratified with the sandstones on its western face presents much the same appearance as that in the Horse's Glen. Both in form and size the two glens are much alike; but the wildness of the latter (in which patches of heath and a few ferns alone are seen) is completely softened down in the former by the luxuriance of the natural wood, principally oak and holly, the abundance and size of the different species of ferns—from the lofty "Brake"† (Pteris aquilina), and "Osmunda regalis"—to the charming little Hymenophyllum, with which the rocks are covered, and by the rich green pasture of the alluvial flat through which the murmuring rivulet flows.

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* *Cappul*, Irish for "horse."

† This fern grows here to a height of more than ten feet.

Here, in the heights, the eagle builds her nest, and hardy and active must he be that would attack her stronghold; here the red deer, "antlered monarch of the waste," strays at his pleasure, with nought to alarm him but the voice of the distant herdsman when driving home the cattle at eventide.

A little east of Cappagh glen, and parallel to it, is a deep ravine or cleft in the mountains. It is separated from the former by a trappean hill, called Benaunmore. This hill is principally a mass of greenish felstone, traversed in several places by dykes, on the east side of which, viewed as you proceed southwards up the ravine, the rock assumes a prismatic structure, caused by joints which fashion it into columns, some of which are upwards of 200 feet in height. Their shape is usually that of a five- or six-sided prism, and they extend for nearly a mile, in one or two places being cut across by dykes of white felstone.

This peculiar structure, and the great height of the columns, particularly when seen towering above the little lake called Lough Nabroda, give a most impressive appearance to the spot.

Eastwards from this, wherever the trap is associated with the sedimentary rocks, it appears to be interstratified with them.

The hill of Benaunmore gives the idea of its having been the focus or volcanic centre whence the ancient molten matter was ejected, and flowed over the bed of the primeval sea in all directions. The aqueous deposits went on again over this mass, and eventually the whole was lifted up from the ocean-bed, and left in its present position.

Could there be a wider contrast than that between the present condition of the peaceful Cappagh, abounding in animal and vegetable life, and the time when it lay in the depths of a gloomy sea, whose waters, rendered noxious by the quantity of iron which they contained, suffered not the existence of animal life,* and but little or no vegetation—when the only thing that broke in upon the monotony of this watery wilderness was the hissing stream of molten mineral matter, so intensely heated that it flowed for miles before it cooled!

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* No fossils of any kind have hitherto been discovered in the old red sandstone of this locality.

The places I have mentioned are accessible to the tourist; who, if he has to use a little extra exertion in reaching them, will assuredly consider himself well repaid for having done so.

THE COMMON FOSSILS OF THE BRITISH ROCKS.

By S. J. Mackie, Esq., F.G.S., F.S.A., &c., &c.

CHAPTER II.

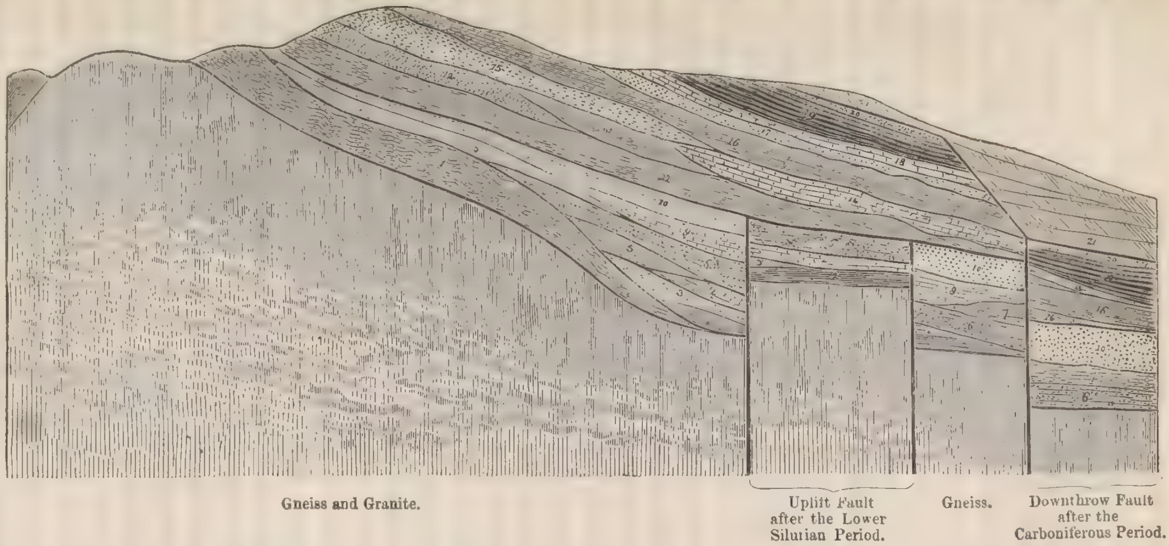
The Rocks—their Order and their Teachings.

(*Continued from page* 64.)

The unstratified Plutonic rocks are considered to form, as we have intimated, the common base of the stratified beds all over the globe. With them, however, we have little to do in this place. Our labours commence with the stratified, and we should even have excluded the so-called "Azoic," had not that term been recently subjected to considerable restriction by the discovery of organic remains in some of its members; and, as it is still likely, by further researches, to be totally absorbed into the Palæozoic system, we append an ideal section representing the sequence of formation of the most ancient groups of fossiliferous rocks, with the relative position of those primordial conglomerates, flags, and schists in which as yet no organic remains have been found. Whether, at the vastly remote period at which those isolated masses, still ranked as Azoic, were formed, the advent of life had really *not* taken place on our planet, or whether those masses are the few remnants of a still older stage of our world than any presented to us by the recognised series of fossiliferous rocks, has yet to be determined by the investigations of geologists—but in their massiveness and their vast age they must ever be regarded with veneration and wonder.

The ordinary diagrams or ideal vertical sections of the superposition of the rocks have engendered to a great extent unnatural and erroneous ideas of proper sequence, and has led to a prevalent impression that the strata were deposited horizontally over each other, like books stacked into a pile. Such, however, is far from the case; the simile would be

Lign. 10.—IDEAL SECTION OF THE PRIMARY STRATIFIED ROCKS, SHOWING THEIR ORDER AND THE SEQUENCE OF THEIR FORMATION.


Gneiss and Granite.
Uplift Fault after the Lower Silurian Period.
Gneiss.
Downthrow Fault after the Carboniferous Period.

21, 21. Secondary Rocks.
20. Red Sandstone and Conglomerates—**Permian Group.**
19. Coal Measures . . } **Carboniferous Group.**
18. Mountain Limestone. }
17. Millstone Grit . . }
16. Devonian Schists and Limestones. } **Old Red or Devonian Group.**
15. Conglomerates and Sandstones . }
14, 13, 12. Ludlow and Wenlock Limestones and Shales—**Upper Silurian.**
10, 9, 8, 7, 6, 5, 4, 3, 2. Caradoc, Bala, and Llandeilo Rocks—**Lower Silurian.** } **Cambrian, of Sedgwick.**
1. Longmynd or Bottom Rocks (Cambrian of Murchison) . . . . . }
O. **Gneiss and Granite.**

more like the reality if the books were supposed to be placed slantingly on a table, each more or less overlapping another. Still this would not be quite the truth; and, if we regarded the books as consecutive volumes of one work, some piled variously over a bottom row of slanting volumes, and others differently disposed and heaped about the table, we should make the example approach still more nearly to the actual manner in which the various strata have been deposited *slantingly* on the shores of the ancient continents, in various large but limited districts, and during certain successive periods only. In this super-stacking of the books we shall have something like the *unconformable* superposition which has taken place where, after the *denudation* or slicing-off of the prominences of the ancient surface, portions of land have *gone down* and the waters of the ancient seas have deposited fresh strata of mineral matter on the older beds at different angles of inclination. Between the elevation of the first beds, during the time they were dry land and the time of their submergence, and that of the deposition of the newer beds, it is evident that other deposits might be going on in other parts of the globe; and that, thus, though the ages of the beds, like the numbering of the volumes, might be continuous, yet, as on the whole table the consecutive volumes might be far apart from each other, so the rocks of consecutive ages might be deposited within far distant areas of our planet.

The sedimentary rocks were, of course, derived from pre-existing materials. They are formed, in almost all cases, of the aggregated particles of sand, mud, and clay originally derived from the disintegration and wearing-down—by the action of the waves, the weather, atmospheric influences, and other causes—of the primordial granites. In some, as in mica-schist,* we may still without difficulty recognize the unchanged scaly plates of glittering mica, just as they sparkled in the derivative mass; in others, the origin of the clay of the decomposed felspar and of the sands of the pulverised quartz is not so easily determined without the skill of the microscopist or the chemist. Lime alone *seems* added to the principal primitive ingredients, flint, iron, and clay. But lime, soda, and potash are known to exist largely in the felspars and micas of the granites; and we are not yet sufficiently aware of the existing relative proportion of lime to state positively that it is more in quantity or volume than could have been supplied from the disintegration of those primitive rocks.

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* Some mica-schists have undoubtedly been developed by metamorphic agencies.—S. J. M.

Let us go back as far in the series of fossiliferous rocks as we can; we still find them, notwithstanding the subsequent alterations to which they have been exposed, presenting similar features to the detrital deposits of our seas and coasts. Even before we detect the traces of organic remains, or the ripple-marks left on the sands of a lifeless shore, we perceive the sedimentary nature of the stone in the disposition of the scales of mica, and of the fine particles of the clayey slate; and we look back almost instinctively for its source to the weather-beaten coasts of the rugged granite-lands of a supposed untenanted globe.

Perhaps, indeed, the records of still earlier stages of our world, and still earlier creations than any we have yet discovered, have been melted down by the fervent heat, or crystallized into those deep and ancient rock-masses.

Such speculations are not yet supported by any decisive proofs, but they may not be the wildest nor most unreal. The doctrine of the central heat of the globe may have to undergo great modifications, for all we as yet know about it is deduced from a limited experience of the variations of temperatures in mines and deep borings, while all indications of its internal fluidity rest wholly on some few intricate and obscure astronomical and physical facts, with the calculations based upon them. We know as yet but very little of the influences which the subtle and wonderful powers, electricity and crystallization, or which the various chemical combinations constantly going on around and beneath us, are capable of effecting. The vast granitic ridges are, however, commonly regarded as the backbones of the earth, as the framework on which the sedimentary crust has been formed—and as such, for our present purpose, we must accept them. But one thing is certain—we may trace at least some, if not all, the materials of the sedimentary rocks back to the granites; but whence the constituent minerals of the latter were derived we know not, nor whether the interior of our planet is homogenous in its substance, or as diversified in its composition as that coating of solid rocks in which it is enveloped.

Let no one be dismayed at the difficulty of at first grasping the marvellous details which geology presents in the formation, order, and arrangements of the rocks. If we stand on the tower of a church, and gaze around on a small town, we can make out the contiguous streets and houses, with their designs and purposes; but, if we stand on a pinnacle of the still higher spire of a cathedral, we cannot comprehend the details of the great city below us without a plan of its structure and the accompanying references to its principal edifices. Still more difficult is it to stand on the mountain-peak, and, even with a carefully-constructed map, to gaze over the apparently interminable ranges of hills upon hills, as they rise fainter and fainter in the grey distance, and to carry off in the mind a just comprehension of the scenery, or of the ever-varying characters of the country. How much harder, then, when our view is world-wide—and should, to be perfect, be world-deep also—for the mind properly to grasp the whole expanse. The outlines of the great territories of the past have been only partially mapped; the references to the principal points may be correctly marked; but where everything is toned down by regularity of succession, and by the obscurity of time, it is only the most prominent features or the great catastrophes and remarkable events that enable the perceptive faculties to conceive that frame-work into which they afterwards, by study and perseverance, fit the more ordinary phenomena, and fill up the spaces as a child fits in the intermediate slices of its puzzle.

Of what are the ancient rocks composed?—Of the beaches, sands, and ooze of the ancient seas and oceans, of the sediments of the rivers and lakes, of the vegetable and organic remains of successive and departed creations. Just as, on our coasts, we find the beaches, sands, and silts derived from the waste of the land, and the rivers bringing down to their lakes and estuaries the disintegrated particles of the soil and the produce of the earth.

We see in the stratification of the rocks the evidence of such depositions; and we see in their materials the sources whence they were derived.

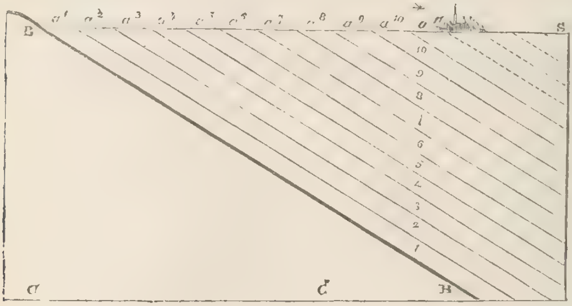
We see in the drift-bedding of the ancient sands the effects of currents piling up the shifting banks in the primeval channels; we can measure the angles of the party-coloured layers of sand, as they incline to various points around; and thus we can map the ancient shoals, and by the gentleness or the steepness of their slopes and by their other features, we can perceive whence the current came, how it rolled the particles along, and levelled off the tops of the banks.

We examine the boulders and pebbles of the ancient conglomerates, and we match them with well-known mountain-rocks from far and near. We perceive at once they are the *debris* of ancient cliffs, and our thoughts turn to the rough waves thundering at their base, and foaming back from their incessant toil, repulsed by the crags and rocks, for weeks and months, only to prevail over and hurl down the stony masses in the end; then, rolling and labouring the broken fragments along the shore, day and night, with the same monotonous cadence as soothes us now on the margins of the great waters, to fashion them into smooth and polished stones. Twenty feet of modern pebbles, a quarter of a mile broad, form a great beach. The great beach of the old red sandstone was probably two thousand feet thick.

Perhaps, however, those wonderful accumulations of the Devonian period ought to be compared with the time and water-worn, semi-angular, and partially-rounded talus of the North American mountains, which is strewn on the borders of the great lakes; the boulders of such origin being usually larger and less smooth than the pebbles of the sea-shore, which are subject to more rapid and far more powerful attrition. The Permian conglomerates may also have proceeded from a like source; and the intermediate coal-measures, in their partly terrestrial and partly fresh-water and æstuarine characters and conditions, seem in no way discouraging to the comparison.

We see, moreover, in the microscopic structure of many of those finer siliceous rocks, which are composed of a segregation of the solid cases of infusoria, and of limestones compounded of nearly equally minute entromostraca and foraminifera, the slowly-formed life-elaborated produce of the tranquil lake, or of the profound abysses of the deep. Our ponds and inland seas give us the key to the one, the soundings for the great Atlantic telegraph that to the other. The silent language of the past, in which these facts are written, appears at first strange and unintelligible, as the tongue of our Saxon forefathers does to us now. But as the languages of the ancient peoples are interpreted by our own, and by those of contemporary nations, so the events and changes of the past conditions of our planet can only be understood by comparison with the phenomena going on around us.

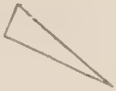
It is commonly stated that we are acquainted with something like a thickness of ten miles of the earth's crust — and what is that to the eight thousand miles diameter? But we do not know absolutely so much. If the strata were spread out and piled up universally one over the other this would be the height of our knowledge; but they are not so stacked nor are they concentrically enveloping. They are tilted up at various angles, and cut off at their outcrops at the surface; great bent domes of rocks, once continuous over miles of country, have been carried wholly away, and their materials re-deposited in the abysses of the sea. Moreover, these beds *never* were strictly *horizontal* except in a few cases; they are generally the produce of the littoral and marginal areas of the pre-adamic oceans, and are most commonly wedge-shaped, thinning out ,or thickening, one beneath the other. Geologists do not dwell sufficiently upon this *sea-marginal and inclined deposition* of the rocks; they are too careless and too ready in their use of the term "horizontal stratification." There is very rarely any such thing in nature, and this little fact makes a *great* difference. Suppose ten strata, all inclined at the same angle, and each half-a-mile thick at its outcrop.



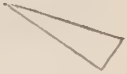
LIGN. 11.—Strata of equal thickness deposited at the same angle, and supposed to be continuous in their dip.

By the argument of original horizontality it is evident we should—by walking over the country, and measuring the thickness or width of the beds at their bassetting edges, a^1, a^2, a^3, to a^{10}—allowing only for the angle of inclination in our measurements—acquire a knowledge of the nature and characters of these rocks equal to five miles in vertical depth at the point a^{11}.

But these rocks were deposited with a diminishing or increasing thickness as the depression or elevation of the old continent on which they rest went slowly on—thus :



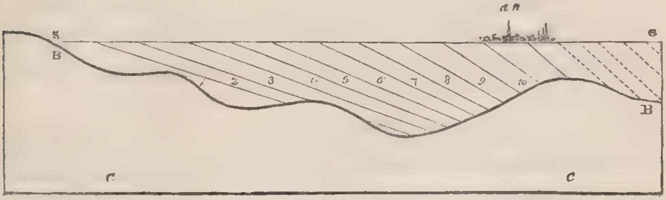
or thus :



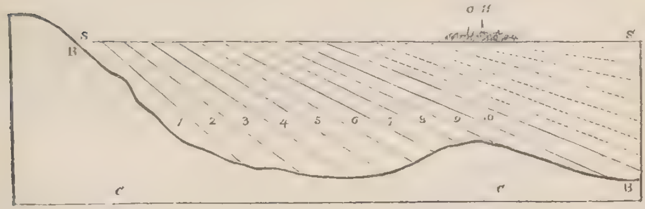
Lign. 12.

Lign. 13.

When these sediments were elevated into dry land, and, as they rose out of the waves, being subjected to the denudation or slicing-off of their upper extremities, they would offer the conditions represented below—thus :

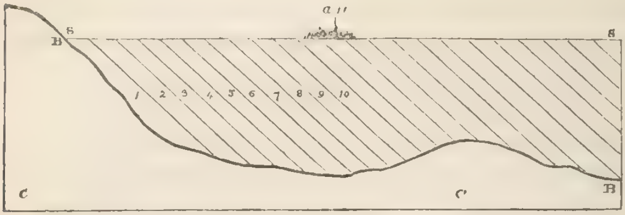


Lign. 14.—Strata thinning out on an old uneven sea-bed.



Lign. 15.—Strata thickening downwards on an uneven sea-bed.

Suppose the beds to be of equal thickness ; then we should not always get a true idea from their outcrops of the *number* of the beds beneath the point a'', (Lign. 16), and consequently we might be as far off in this case as the others from a knowledge of the rocks beneath that spot.



LIGN. 16.—Strata of equal thickness deposited at the same angle on an old uneven sea-bed.

The amount of strata at this given point, a'', depends on the *depth of the ancient sea-bed* at the period when the uppermost rocks there were deposited, as each of these three diagrams will show. Yet it is from this mode of calculation, by taking the thickness of the strata at their outcrops, and imaginarily piling them one on the other, that we are said to be cognizant of the structure and condition of *ten miles* of the earth's crust.

Our ideal section (page 93)—based, however, on truth and facts—exhibits the first recognizable sediments, the Harlech grits and Longmynd rocks (No. 1) belonging to a more remote stage of our world than the great accumulations of the Silurian slates, grits, and conglomerates which succeed them. We perceive the evidence of this in their unconformable infra-position, the Silurian strata abutting against the slopes of these "bottom-rocks," as these last do against the primordial gneiss banks; and as the sedimentary beds rise *higher and higher*, they show how the primitive land must have been gradually and slowly *submerged* beneath the waves for the accumulating deposits to have been spread out *above and above* each other.

Those "bottom-rocks" might not have been dry land before the succeeding Silurian sediments were formed—though possibly they had been elevated, and were,—but that they went down and down, deeper and deeper, is certain from the tens of thousands of feet of solid earth, with the innumerable lifeless forms they enclose, now piled above them. The old authors believed the sea to rise and fall and change its level, and regarded the eminences of the land as the types of age and stability. "As old and unchangeable as the hills," "solid as the mountains," "which can never be moved," were the figures of speech they expressively employed. We regard the sea as the emblem of eternity, and as

> "Unchangeable, save to its wild waves' play
> Time writes no changes on its azure brow;
> Such as creation's dawn beheld, it rolleth now."

We know the land in our own age is slowly rising from the sea in some parts of our world, and slowly going down in others. We know that ten thousand feet high upon our mountains the solid rocks contain the *debris* left by the waves; and that higher still on their lofty sides are mounds of shelly gravels, and we see in the faults and fissures of their gorges the powers of the ancient earthquakes.

In our own days we have seen the cities rock and reel like drunken men, and thousands of human beings engulphed in the yawning chasms; in historic times, we know, others have been buried beneath the showers of scoriæ and ashes, and the lava-streams of flaming volcanos. Amidst the sediments of the past we find the grey consolidated grits of primeval eruptions, and great dykes and walls of lava, trap, and basalt piercing and penetrating the solid beds of stone. We find the consolidated lakes of once-molten matter intercalated between sedimentary formations of various ages; and so we know that the volcanic forces were as intermittent in their action during the pre-adamic periods as in our own.

The ancients, with *fewer facts* before them, said the sea was unstable; we say, the land. May not a dispassionate investigation of *all the evidence* prove advantageous to the truth? Great continents are thought to have *gone down*, others to have risen up. The great submarine plateau, over which the electric messages soon will pass, looks very like one of the former; would the ocean level remain unchanged by submergences as this? We had, in one not very distant period, two classes of Geologists—the Plutonists and the Neptunists—living in two opposite districts, the one gazing on the fire-formed, the other on the water-formed rocks; but neither looking beyond their own limited arena. And, as Hutton combined the correct elements of both their doctrines, might not a modification of the views of both oceanists and terrestrialists be attended with beneficial results? Still, for present purposes, we may accept the recognised doctrine, and regard the ground beneath us as having been subjected to many vicissitudes, and to frequent and more or less vast and important fluctuations of level; that, sometimes above the waters, it has been clothed with vegetation and with appropriate forms of animal life, and sometimes beneath the waves, fresh sediments, enclosing the creatures of the deep, have covered the terrestrial conditions that were; and then again uplifted, the new deposits have been covered with verdure, and fresh forms of living creatures have appeared.

A glance at the section (p. 93) will show that, for the purpose for which, at my request, my talented and highly-valued friend, Mr. T. Rupert Jones, designed it in connection with these papers, it is necessary only there to indicate the great disturbances which affected our own area during the Silurian period, and those other great disturbances by which the Palæozoic period was terminated and cut off from the Secondary or Mesozoic period, which succeeded it. In the grand sequence of events there displayed, we have, first, the gneiss and "bottom rocks" upheaved; then a sinking of the land for ages, with accumulations of sediments; a counter-upheaval of a large tract, with a general denudation of the surface followed by a continued gradual subsidence of the whole, with more and more deposits, continued up to the period when the sediments had well filled up extensive portions of the ancient sea-bed, forming low banks and islands, and æstuarine and land-lock coasts, on and around which the gigantic vegetation, which the warm and humid atmosphere nourished and fostered, grew in wild luxuriance, and, mingling with the drifted trees and plants brought by the rivers and currents to the tranquil bays, formed part of that great accumulation of vegetable matter which has been since, by the chemistry of nature, elaborated into that wonderful and invaluable mineral, coal. After the deposition of the coal-measures, something like the ancient conditions returned; the new red sandstone formation spreading out above them, so like the old red sandstone series beneath in its marls and conglomerates, that only by position and by the difference of the creations each has entombed, can the one be distinguished from the other. With the Permian catastrophes *our* share in the first world ended. But these catastrophes were not universal. The disturbances which have made the line of demarcation between the primary and secondary groups of rocks so strong in our own island, were limited in their area and in their effects. In other spots the lands was still gradually rising or sinking, the sediments still falling on shores and sea-beds, and adding new strata to the ancient rocks, or being slowly lifted out of the waters, to form fresh fields and mountains. The order was not broken, it was only *continued elsewhere.*

And thus, too, we pass upwards, through that second world and that third world, to the present world, stage by stage, to find newer creations entombed in the newer beds; for, although the sands, clays, and limestones may *repeat* themselves in their peculiarities of structure, the the embedded species of animals and plants *never* do. *They* are always different in each succeeding stage, however like are the conditions of the rocks. So, too, as we pass upwards through periods of ages, ever and ever it is from the waste of older lands, from the wear and tear of pre-existing materials that the newer soils are formed—only the older deposits were less elaborated by repeated regenerations, were more uniform in their characters over extended areas. All the limited notions of the popular belief respecting the age and antecedents of our planet are as totally crushed by the Evidences of the Rocks as they are by the testimony of their fossils. Coast-lines have altered, and lands which were are lands no more; sea-beds have been changed into verdant fields, and where the shell-fish crawled, now grows the yellow corn.

What fossils teach us of former worlds of life, the rocks teach us of former worlds of land and sea, until we seem almost to be telling the same tale and repeating ourselves.

(*To be continued.*)

FOREIGN CORRESPONDENCE.

BY DR. T. L. PHIPSON, OF PARIS.

Contents of three letters addressed to M. Elie de Beaumont—Lias formation of the Col d'Encombres (Alps)—Directions of the veins of lead and zinc ores in Prussia and in France—Geological investigations in Chili—Silver and copper in the waters of the ocean—Why there is no gold in them—Auriferous sand from the Isle of Bourbon—Effects of plutonic rocks on lignite, coal, anthracite, and graphite.

At one of the recent meetings of the Academy of Sciences, M. Elie de Beaumont noticed three letters which he had received that, from their geological interest, we will briefly refer to here.—The first, from the Piedmontese geologist, M. Sismonda, treats of the fossil beds of the Col d'Encombres, in Savoy. By their researches in the geology of this country the author, with his brother and M. Bellardi, confirms the conclusion they arrived at in the year 1848, that the anthraxiferous formation of the Alps belongs to the Liassic age. Perhaps no other stratigraphical group has given rise to so much discussion as the one of which we now speak. The presence of coal and anthracite in the limestone-formations of the Alps long ago attracted particular attention to these strata. What would our English geologists have thought, in 1830, had they observed a seam of anthracite or coal imbedded in the white chalk of Dover cliffs? Would it not have led to a strict examination of the stratigraphical relations of this chalk, and a more minute investigation of its fossils; more especially if these were broken, cemented together, and difficult to determine, as they are in the Col d'Encombres? That is precisely what has taken place regarding the Alpine strata; and since the year 1830, or thereabouts, up to the present time, they have been shifted about on geological tables and maps, from the white chalk to the coal-measures, from these to the white chalk again; from the latter they have travelled to the Jurassic formations, to be finally* fixed in the Lias. Studer, Brongniart, Brochant, and D'Omalius, have all striven to solve this problem; but for the elucidation of the discussed points we are mostly indebted to the admirable labours of M. Elie de Beaumont, who first got a glimpse of the real nature and position of the Lias strata of the Alps.

The list of fossils from the limestone of the Col d'Encombres shows in all 63 species, of which 35 only can be specifically classified by the examination of fossils already known. Of these 35 belong to the superior, inferior, and middle strata of the Lias, with the exception of four, which are attributed by M. Sismonda to the stratum known as the Inferior Oxfordian bed. A remarkable circumstance, which deserves especial notice is, that from Professor Sismonda's account, the fossils which modern palæontologists look upon as belonging to different strata, are, in the Lias of the Alps, all found in one bed. Thus, at Col d'Encombres, all those belonging to the three Lias beds are found in one single stratum.

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* It is impossible to regard this vexed question as definitely settled, even after these late researches of MM. Sismonda and Bellardi; for we must not forget that M. Favre, and other equally talented and experienced Geologists, still consider that distinct Liassic beds are intermixed, by inversions, in some cases, with true Carboniferous beds, in these Alpine Anthraxiferous strata; although some refer the whole to the Jurassic series, and others place them all in the Carboniferous.—Ed. of Geologist.

M. Elie de Beaumont, on presenting this letter to the Academy, observed that the persevering researches of Professor Sismonda cannot be too highly praised. Having lately visited the Col d'Encombres himself, he gave an interesting account of his recent excursion there, and explained the position and structure of the beds indicated by M. Sismonda. These vary from 7½ to 10 or 11 feet in thickness; they are covered by about 100 feet of calcareous strata, apparently devoid of fossil remains, and repose on a bed of grey crystalline limestone, presenting a few veins and blocks of black silica, which emits a bituminous odour when broken. It is very difficult to extract the fossils from these deposits, so firmly are they cemented together by the crystalline limestone. These beds of limestone have, however, completely escaped the metamorphic action which has so thoroughly modified the mineralogical characters of the surrounding strata. From this fact, and from the circumstance already mentioned of all the fossils of these three Liassic divisions being here distributed in one single bed, M. Elie de Beaumont is of opinion that the fossil beds of the Col d'Encombres will in future be regarded as one of the most classical and remarkable of the Liassic formations.

The second letter addressed to the learned Secretary of the Academy was from M. Rivière, who is studying, in Prussia, the direction of the veins of zinc and lead ores. A short paper enclosed in it, and entitled, "*On the general direction of the veins of Blende and Galena*," contains the following results: On the right side of the Rhine, as the author has previously shown, the general direction of these veins (which are encased in the Grauwacke and Phyllades* of the country) is east 30° north, west 30° south. Towards the latter part of last year he found that the veins on the left side of the river not only show a similar nature and structure, but appear to have the same direction, as those on the right side; of which, in fact, they seem to be a prolongation. M. Rivière has also studied the same metallic veins in La Vendée, Auvergne, Forez, Ardêche, Cevennes, the Alps, &c., and now arrives at these conclusions: first, that there is a remarkable constancy in the mean direction taken by the veins of Blende and Galena throughout a great part of France; secondly, that these veins run generally north-west and south-east, inclining rather to the west and to the east, and seeming to appertain to M. Elie de Beaumont's *Système du Morbihan*, which he has defined by a line to the west 38° 15′ northward, and to the east 38° 15′ south; thirdly, that the veins in question are generally encased in the primitive rocks (granite, gneiss,* mica-schist, talc-schist, &c.), never occurring higher than the Silurian strata, properly so called, and belonging, therefore, to a very ancient system of dislocation. Our readers will readily appreciate all the importance and utility attached to these investigations.

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* Clay-slate.—Ed.

The author of the third letter, dated Copiapo, the 16th September, 1857, is from M. Pissis; it relates to a geological exploration of some parts of Chili. The writer informs us that he is, at present, studying the province of Atacama, of which he hopes to have a geological map completed before the end of 1858. The stratigraphical characters of the southern parts of Chili bear a great resemblance to those of the Brazils, and the upheaving of the strata seems to belong to the *Hundsruck system;* the direction of which, in Chili, is north-east and south-west, which is also that of the granite and talc-schist of the country. But, independently of this, there is a large band, from fourteen to eighteen leagues wide, of other formations running parallel to the coast, some of the strata of which are remarkable for the abundance and beautiful preservation of their fossils. The working of silver and copper mines is becoming every day more and more active there, not only in the inhabited districts, but even in the desert.

A short time ago, in the year 1856, an Englishman residing in South America, but whose name we cannot think of at this moment, discovered the presence of silver in the water of the Atlantic Ocean. He was surprised to find a small quantity of silver in the copper-sheeting of vessels which had navigated for some time. He analysed, first the new copper before it was placed on the ships, then the old copper taken from the bottom of ships that were undergoing repair. The results of his experiments were, that the copper taken from ships that had navigated during the longest period of time contained the most silver; those which had only made short voyages contained very little more silver than that which was originally found in the new copper-sheeting.* Similar experiments were lately made in France by MM. Durocher and Malaguti, whose conclusions coincide with those arrived at in South America. The existence of silver in sea-water cannot therefore be doubted. The presence of this precious metal in the waters of the ocean is without doubt due to the property possessed by common salt (chloride of sodium) of dissolving chloride of silver—

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* Which almost always contains slight quantities of silver.

a salt which silver is very apt to form, and which is one of the most plentiful of the silver-ores. Small particles of it are constantly washed down by probably most rivers, and carried to the sea, where it is dissolved by the salt-water.

Copper has just been discovered in the water of the Mediterranean by M. Septimus Piesse, whose remarks have been published by our Parisian contemporary, *Cosmos*. To the sides of a steam-vessel going from Marseilles to Corsica, the author attached bags filled with nails and iron-filings. Iron having the power of displacing copper from its combinations, the iron nails and filings were found on examination to have extracted from the water a notable quantity of copper, which adhered to the nails and iron-filings. Certain soluble salts of copper, such as the sulphate for instance, which are not easily decomposed by natural agents, are probably carried down to the sea by rivers, together with insoluble particles, such as sulphide of copper, which, by long contact with sea-water, would transform itself into sulphate or chloride of copper, and be dissolved. M. Septimus Piesse has gone so far as to attribute the blue and green colours of certain parts of the ocean to salts of copper. But this was a rash step to take, and it would have been more reasonable had the author contented himself with stating simply the discovery of a small quantity of copper in sea-water—a discovery not devoid of interest—rather than attribute to this source the coloration of the waters of the ocean, which may be due to a thousand more likely causes.

In searching for copper by the above means, gold, if any were in solution in the sea, would certainly have been found. None of this most precious metal has ever been discovered in sea-water; and why? The reason is obvious—salts of gold are very easily decomposed; the least particle of organic matter decomposes the soluble ones, and precipitates their gold. Hence, when gold is met with in nature, it is always in the metallic state. It is impossible, therefore, that it can ever be found in sea-water, although no doubt exists as to a million or two sterling being washed down now and then by the various rivers, and swept into the sea in different parts of the world. If we wish to discover maritime gold we must look for it in the sand of the sea-beaten shores.

This reminds us that we have just received a sample of sand said to be auriferous, and recently imported by some speculators from the coast of the Isle of Bourbon. This sand is extremely interesting, first, by the great distance whence it has found its way into my laboratory in Paris; secondly, by its composition and aspect; and, last, perhaps not least, from its containing small quantities of gold. Three or four analyses made in Paris show that it contains $\frac{1}{50000}$th of its weight of gold: it is almost entirely black, of a very fine grain, and, from the slight examination I have as yet given it, appears to consist chiefly of nigrine (titanate of iron), mixed with grains of quartz, garnets, corundon, &c. The nigrine is easily separated from the rest by means of a magnet, for this mineral is extremely magnetic. There are a great number of other black grains, however, upon which the magnet has no action, and which appear to be either *debris* of basalt rocks or crichtonite.*

It would certainly be desirable and, perhaps, profitable, were some of our English ships touching at the Mauritius to bring back to England samples of sand taken from the coasts of the last-named island, whose geological structure is identical with that of the Isle of Bourbon,† and whose shores are doubtless strewn with a similar auriferous sand. Analysis and experiment would soon decide if the washing of this sand for its gold would prove a profitable undertaking, and whether we should thus be enabled to join to the organic produce of the Mauritius a mineral of quite as much importance. Besides the sand of which we speak, the ocean throws on to the coasts of the Isle of Bourbon (and I have reasons to suppose, on to the coasts of the Mauritius also), round blocks of what appears to me to be a species of trap-rock, which also contains a notable proportion of gold.

M. Delesse has lately made known‡ the results of his investigations on "The Metamorphism of Rocks."§ We extract what appears to us most interesting.

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* Another species of *titanate of iron*, which is not magnetic.

† Both are volcanic islands: their soil is strewn with lava, basalt, &c. Bourbon has one volcano still active; those of Mauritius have long since ceased their eruptions.

‡ In a series of memoirs, of which extracts have been given in the "Comptes Rendus," from September to December, 1857.

§ *Transformed or metamorphic* rocks are those in which the internal texture, the mode of stratification, and sometimes the chemical composition, have been changed either by contact with, proximity to, a plutonic or volcanic rock of eruption. (For details on this interesting subject see Humboldt's "Cosmos," vol. I, p. 248, *et seq.*)

In one of his memoirs the author treats exclusively of the changes undergone by combustibles, such as lignite, coal, &c., under the modifying influence of some eruptive rock. In nature we find that fossil-wood modified by metamorphic action has become coal ; coal, anthracite ; and anthracite, graphite. Sometimes such transformations have taken place on a very large scale ; an entire stratum of coal, for instance, has been transformed, by the action of some upheaved rock, into hard anthracite. M. Delesse calls this *normal metamorphism.* At other times, on the contrary, metamorphism is only observed to have occurred in that particular part of the combustible stratum which is immediately in contact with the eruptive rock. This is *metamorphism by contact.*

In normal metamorphism the combustible loses successively its bituminous matter, becomes comparatively richer in carbon, more compact, and augments in density. Last of all it become crystalline, passing to the state of graphite.

But in metamorphism by contact the changes are more complicated, and depend, in great measure, on the particular kind of eruptive rock that produces them. When lava, vomited by a volcano, flows over and envelopes pieces of wood, the wood becomes, in a greater or lesser degree, perfect coal. Some carbonized wood found in the ancient lava of Auvergne contained a certain quantity of carbonate of lime and oxide of iron, showing, perhaps, that in such cases the combustible matter may be impregnated with mineral substances. It is not often that we see granite and quartzose porphyry in contact with combustibles ; but some few cases of such contact have been observed. For instance, the coal-measures of La Pléau, in France, spoken of by Beudant, which are in some parts imbedded in the porphyroid granite of this district, and the coal-strata of Altwasser, in Silesia, visited lately by M. Delesse, where the coal in contact with porphyry has been changed into prismatic anthracite, and furnishes, by combustion, 15 per cent. of ashes, principally formed of oxide of iron. In cases where combustibles are found encased in granite-rocks, they are observed to have lost their bituminous matter, and to have become anthracite or graphite. Up to the present time, according to M. Delesse, no *coke* has ever been found in contact with granite-rocks ; it seems probable, however, that laminæ of graphite found in them have been produced by their metamorphic action on certain combustible or bituminous matters.

Trap-rocks, as basalt, dolerite, hyperite, euphotide, diorite, and trap properly so called, are often found in contact with lignite, coal, anthracite, and even graphite. In these cases metamorphism has sometimes been very feeble or null. In the Giant's Causeway a sheet of trap has overspread a bed of lignite without causing the slightest alteration in the structure or aspect of this substance. Such extraordinary examples as this are, however, very rare, and require elucidation.

Generally speaking, the contact of trap-rocks either renders the combustible more compact, or changes it into a species of coke. In the former case lignite becomes coal, anthracite, and sometimes graphite. When any combustible has been thus modified by the presence of trap-rock, it is observed to have taken a prismatic structure in those parts which are immediately in contact with the eruptive rock. M. Delesse has observed this curious fact in lignite, coal, anthracite, and also in graphite.

This prismatic structure is very difficult to explain, and is rendered the more so by the fact that samples presenting it shrink still more when they are artificially heated, evolving, at the same time, water and volatile bituminous matter, and becoming genuine coke.

We shall refer again to other observations on metamorphism made by M. Delesse. We have dwelt on the foregoing more particularly as they contain a few facts confirming ideas that we ourselves have cherished for many years, and which embrace some of the most interesting geological phenomena. We will endeavour to lay them before our readers at some future period, which we hope may not be far distant.

GEMS FROM PRIVATE COLLECTIONS.

(By the Editor and his Friends.)

I.—AMMONITES COMMUNIS; FROM THE LIAS OF WHITBY, YORKSHIRE.

In the Collection of J. S. Bowerbank, Esq., F.R.S., F.G.S., &c.

At the extremity of a pretty bay, on the coast of Yorkshire, stands the town of Whitby, known to every geologist for the numerous treasures of organic remains which the Lias beds, there outcropping on the shore, have furnished at various times.

Nor is Whitby wanting in historical associations. It was there, in Anglo-Saxon days, stood the far-famed monastery of Streones-healh, of which St. Hilda, the relative of Northumbria's powerful monarch, Edwin, was the abbess. It was there the famous council was held to decide the keeping of Easter (A.D., 661); it was on those rugged shores of the North Sea that the early stand was made by Colman on behalf of the native religion against the then increasing dominion of the Romish Church. It was there reposed the remains of Edwin, Oswy, Aelfleda, and of the Saxon Hilda herself. Associated with its monastic rule were many of the famous men of the olden times—Bosa, Aetla, Oftfor, Wilfred, and Cædmon, to whom Bede says sublime strains of poetry were so natural that he dreamed in verse, and composed in sleep that which he penned on awaking. And the history of Whitby is pleasingly associated with its geology by the legend of its saint.

Of all the numerous fossils which occur so abundantly in the Lias none are more common, and few more beautiful, than the abundant form we have figured, the Ammonites communis, so long and so well-known as the "Snake Stones," into which St. Hilda, by her devotional fervour, is reputed to have changed those obnoxious reptiles in this district.

Sir Walter Scott alludes to this as well as the other legend respecting this saint in his noble poem of "Marmion."

At the banquet which is spread after the voyage of the abbess in the old monastery of Streones-healh, the nuns relate:—

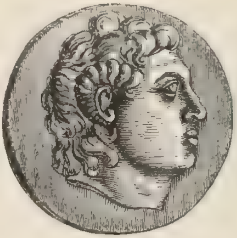
> "How of thousand snakes each one
> Was changed into a coil of stone
> When holy Hilda prayed.
> Themselves within their holy bound
> Their stony folds had often found."

The snakes, however, appearing to have lost their heads, and to have been decapitated before or in the process of petrification, these fossils became a source of great tribulation to those who thus attempted to account for their origin. The "curiosity" dealers knew better how to treat the subject, and carved heads out of the matrix, demanding high prices for these so-styled "perfect" specimens.

The generic name Ammonites has its origin in the fancied resemblance of these shells to the ram's horn with which the antique heads of Jupiter Ammon are sculptured: hence by early writers they were called Cornua Ammonis. Amun or Ammun, of the Egyptians; Zeus Ammon or Hammon, of the Greeks; Jupiter Ammon, of the Romans; were the designations of an Egyptian god, or more properly of a deity of Ethiopian extraction, worshipped over a considerable portion of Egypt, and frequently found figured with a ram's head and a human body in the monuments and works of art of that country. Herodotus gives us the following story in relation to these curious attributes of the god:—Heracles, or with us more popularly Hercules, being with his army in the deserts of Africa, so importuned the god Zeus, who did not wish to show himself, that Zeus at last hit on this expedient—flaying a ram, and cutting off its head, he put it before his face, and then getting into the skin, showed himself to

Hercules. Thus the ram's horns became the peculiar emblem of Ammon.

The astronomical character of Ammon, as the ram in the signs of the zodiac is of much later origin, not older than the sixth century before Christ; and in still later times, the Greeks regarded him as the pervading spirit of the universe, and as the author of all nature. This was probably an extension of his original attributes. In Jablonski's "Pantheon" are numerous suggestions as to the derivation of the name. The most probable seems to be from the Coptic Ammon or Amun, "to feed sheep:" hence we may consider him as properly the god of a Nomadic race, or as typical of the political union of some ancient pastoral tribes.* The horns of Jupiter Ammon were first appropriated by Alexander the Great, who, after his conquests, assumed the title of Son of Ammon, and the emblem of the god. On the early coins of this prince we find the head wearing a helmet; in those of a later date the ram's horns appear, but they are of a plain form; towards the close of his reign are coins bearing horns with markings upon them; but the earliest coins with which we are acquainted, in which that peculiar kind of lobed horn appears which most nearly resembles the chambered divisions of the Ammonites, are those of one of his generals, Lysimachus, to whom the kingdom of Thrace was allotted, and who fell (B. C. 282) by the hands of his own subjects, excited against him by his unjust execution of his son.



Coin of Lysimachus, with the horn of Ammon.

The term Ammonite was proposed, for this particular class of cephalopodous mollusca possessed of chambered shells, coiled on the same plane with the divisional septa of a figured and intricate pattern, by Lamarck, in 1811; and under this head he placed the Turrilites, Baculites, and other similar shells, which have subsequently, for obvious reasons, been raised into distinct genera.

Ammonites occur only in the fossil state, and are limited in their vertical range in the series of rocks to the Jurassic and Cretaceous formations, first appearing in the early members of the one and disappearing in the later members of the other. As essential characters in distinguishing this genus from others of the same group, it may be added

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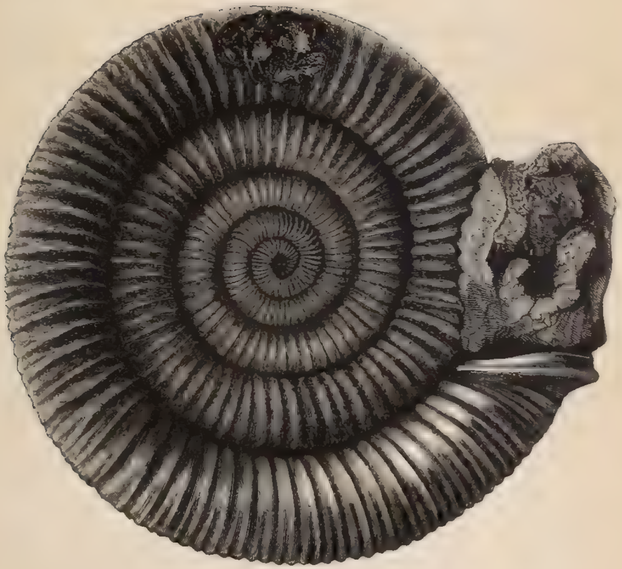
* Possibly "the great Pan," was a "geographical representative" (as modern naturalists would say) of this great deity of the Ethiopians.

PLATE III.



AMMONITES COMMUNIS.

From the Lias of Whitby, in the Collection of J. S. Bowerbank Esq. F.R.S. L.S. &c.

S. J. Mackie Del.

that the whorls are contiguous and more or less embracing, the chambers numerous, and the siphuncle dorsal, or on the outer edge. The mouth is usually more or less bordered or lobed, and in some cases constricted at a longer or shorter distance below its margin. Several hundred forms have been figured as species, but some reduction of the number will most likely take place as we become more and more acquainted with the variations of form at successive periods of growth, the aberrations of specific characters from local influences, and not unlikely the even possible differences of the sexes.

The first English work in which the Ammonites communis was described and figured is, we believe, Sowerby's "Mineral Conchology," in which a variety is also figured under the title of Ammonites angulatus.

The beautiful fossil we have figured is a perfect specimen of the species, possessing, without the slightest damage, the constricted and bordered mouth of the adult individual. S. J. M.

MR. PRESTWICH'S REPLY
TO THE LETTER OF THE REV. C. KINGSLEY ON THE "HAGGERSTONE."

To the Editor of The Geologist.

London, 22nd February, 1858.

Sir,—I quite agree with the Rev. Mr. Kingsley that the Haggerstone of the Isle of Purbeck is not a transported boulder, but merely a remnant *in situ* of some partially-removed Bagshot strata. I also think it probable that a great part of the Bagshot series of Hampshire and Dorsetshire is derived from the wear and destruction of a land of the older and crystalline rocks—such rocks as now form the surface of Cornwall and Brittany; and as the strata show greater fineness of material at White Cliff Bay than at Alum Bay, in the Isle of Wight, and as again they are still coarser around Poole Harbour, where they often pass into grits, it is probable that much of the material of which they are formed was drifted from a land nearer to the Poole area than to the Hampshire area. On prolonging a line from the latter to the former, it will point in a direction west and south-west; *i.e.*, towards an old land, of which Cornwall and Brittany remain as the non-submerged portion. The evidence afforded by the organic remains points to the same conclusion, for the plant remains are more numerous, and on the whole better preserved as we proceed from east to west, being few and indistinct at White Cliff Bay; more numerous as well as more distinct at Alum Bay; and still more plentiful at Bournemouth and around Poole harbour—the leaves having become necessarily more and more decayed as they were drifted away from the land in which they grew. At the same time, shell remains are very scarce around Poole, and are altogether absent at Alum Bay; but they appear in some abundance at White Cliff Bay, and are most numerous at Bracklesham Bay, where, farther out in the old sea, marine life flourished under more secure and perfect conditions. At the same time, the old rivers of this Bagshot Sand Period traversed a land abounding probably in decomposing granitic and syenitic rocks, such as we now find in Cornwall and Brittany and also in the north-west of Spain, and bore down to sea, during certain periods, the fine kaolin clays and other impalpable soils of the district that now form the argillaceous beds and valuable clays of the tertiary lands of Dorsetshire and Hampshire; whilst stronger floods or currents drifted at intervals out into the same sea the coarser sediment and fine quartzose grits forming the other portion of the decomposing rocks before alluded to. I do not mean to say that the changes were periodic,— they were more probably secular, resulting from a change in the directions of the old rivers; for we cannot suppose the great thick beds of sand and of clay to be each the measure of a single period of flood or of calm. Each generally shows, on the contrary, a change maintained for a given time. Mr. Kingsley has called attention to a very interesting subject, requiring yet much labour to elucidate. I throw out these remarks merely as a guide to the direction in which I conceive they should tend; the first step being, not to go to a distance in search of a solution to a problem without first looking, as Mr. Kingsley did, for an explanation on the spot, and within the area, where the thing observed and questioned presents itself.

I am, Sir,
Your most obedient servant,
J. Prestwich.

NOTES AND QUERIES.

The Rev. C. Kingsley's Letter. (Page 75.)

We are under the impression that Mr. Prestwich, in some of his papers on Tertiary Geology, has referred the origin of the Dorsetshire clay beds and their accompanying sands to the action of certain rivers that traversed an old granitic and basaltic land, of which Brittany and Cornwall are remaining portions.

What Mr. Kingsley terms "a guess" is a very good hypothesis that would find much support in the published researches of Mr. Prestwich. The three lectures delivered at the Clapham Athenæum by the latter gentleman, and recently printed under the title of "The Ground beneath Us," contain an outline map of a portion of the old Tertiary lands, with much interesting information bearing on the question.

A very careful examination of the structure of the particular beds around Poole, conducted almost yard by yard, would be essential to the full comprehension and decision of the point Mr. Kingsley has mooted.

A great deal of special information on the physical history of the Tertiary sands and clays will be found in the numerous communications of late years, by Mr. Prestwich, in the Quarterly Journal of the Geological Society; and Mr. H. Sorby's article in the Edinburgh New Philosophical Journal on the old æstuary deposits of the Isle of Wight will also help in the research.

Such valuable interrogations as Mr. Kingsley's deserve every attention, and we believe our readers may anticipate a ready reply, in our next number,* from one of our most eminent Tertiary geologists; but, lest the question should appear to be neglected, we have inserted here what is generally known to geologists on the subject.

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* An explicit reply from Mr. Prestwich having reached us just before going to press, we have inserted it on the preceding page; but as the above notice contains reference to published works on the subject, we have thought it best to allow it to remain.

A Correspondent, in the last number (page 80), asks some questions on supposed mammalian remains in the Lias. We are obliged by the offer of sketches, which we shall be glad to receive. As far as can be judged from what we know of other mammalian-like bones which have been rolled down from the storm-beaten cliffs of the Dorsetshire coast, it is probable that geologists will have in these fossils the remains of great Megalosaurian reptiles or Dinosaurs similar to those which are already so well known in the Oolite and Wealden formations—some members of this family having been found even as low down in the series as the Trias at Wurtemburg. From their latter position we need not be surprised at their occurrence in the Lias, which was probably the deep-sea formation fringing the lands which supplied, in successive ages, the remains of this interesting family of reptiles, the chief characters of which may be studied in Mr. Waterhouse Hawkins's magnificent models at the Crystal Palace.

T.V., Durham (see page 80).—Durham is one of the finest places in the kingdom for a working geologist. The "Marl Slate" of the Magnesian Limestone series is especially to be noted as full of splendid and almost perfect fish. Its outcrop will be found at Ferry Hill, and many other places in the neighbourhood; and it is often cut through in the coal-workings. The whole Permian group of the north of England is of the highest geological interest, and is divided by Professor King into six divisions. 1st. Crystalline earthy compact, and oolitic limestones. 2nd. Brecciated and pseudo-brecciated limestones. 3rd. Fossiliferous limestone. 4th. Compact limestone. 5th. Marl-slate. 6th. Various-coloured sandstones. Passing from Bolden to the coast, the series is crossed in ascending order, the lowest member (6) occuring on the west of Down Hill; then the marl-slate (5) is seen, overlaid by several beds of brown-coloured limestone (4). The beds of light-coloured limestone (3), abounding in fossils, occur at Hylton North Farm, and Southwick Lane House; while in the west quarry at Southwick, the brecciated and pseudo-brecciated deposits (2) are displayed—the superimposed crystalline and other limestones being extensively worked in the Fullwell quarries, and continuously displayed to the shores of the German Ocean. The great 90-fathom dyke is a physical phenomenon well worthy of note; and Cullercoats Bay, the railway-cutting at Thrislington Gap, Tunstall Hill, Ryhope, Hartlepool, and Tynemouth are places well known to geologists. We have replied as fully as our columns will permit; and we must refer T V., if he desires more detailed information, to the monograph of Professor W. King, in the publications of the Palæontographical Society; the papers by Mr. R. Howse in the "Annals of Natural History," vol. xi., 2nd series; and the remarks by Mr. Kirkby in the Quarterly Journal of the Geological Society, vol. xiii. The labours and writings of the Rev. Professor Sedgwick and of Sir Roderick I. Murchison are also of the highest importance in the study of the Permian deposits.

Verbum Sap.—The publication of an illustrated glossary or dictionary of geological scientific words and terms was proposed by the present Editor to the late proprietor, but the idea was not entertained. This matter is now again under consideration, and will most probably be carried out. Some time, however, must elapse before its practical execution can be commenced—the mere manual labour of writing out and arranging in alphabetical order the numerous expressions and technicalities of a science being by no means a trifling operation. In the interim of its preparation, questions from correspondents and subscribers will be freely and readily replied to; and our subscribers and readers would do well to note down such words and terms as they are desirous of having explained, or which they think it advantageous to notice for the sake of others. Such communications should be marked "Glossary," to save us the expense of printing special answers.

J. H. W., Nottingham.—"To the Editor of the Geologist.—Dear Sir,—I should be greatly served if you will inform me upon the following questions: To what geological formations do the Himalaya mountains belong? Whether there is evidence of the geological period of their upheaval, and has there been any organic remains discovered upon them? The same questions with reference to the Andes. I have heard the word 'Gneiss' pronounced in so many different ways by eminent men, that I should be obliged if you would give the pronunciation adopted generally by geologists. If you will refer me to works in which I can find solutions to the above questions I shall be satisfied."—The Himalaya Mountains comprise an axis of crystalline schists traversed by granite-veins, on the northern flank of which are clay-slates, palæozoic rocks, and secondary fossiliferous formations, including Oxford-oolite and Muschelkalk. These are succeeded by the great elevated Tertiary plains of Thibet. On the south side, secondary and tertiary deposits lie against the schists, and are flanked by the well-known Siwalik Hills of Miocene age and the Pleistocene beds of the plains of India. Of the evidences of upheaval, we may conclude that, as the tertiary beds have suffered with the other rocks, the latest movements of elevation must have been after the period of their formation. Organic remains occur in the Oxfordian beds at a very high elevation in these mountains.—The Andes: Mr. Darwin, in his remarks on South America, in the "Voyage of the Beagle," says that the Tertiary rocks of the Andes have not only suffered in the elevatory movement, but have been also greatly altered by the eruptive rocks that have been agents in the uplift. Hence the latest elevations in the range are also subsequent to the formation of the older Tertiary rocks.—The word "Gneiss" is pronounced very nearly like our English word "nice;" the exception being the slightest indication of the letter "g." This would be in accordance with the German pronunciation. J. H. W. will also find information on his geological questions in several popular works, such as "Mantell's Wonders," "Lyell's Manual," &c.

Under what circumstances does allophane occur in this country?—Z.

I have sometimes seen mention of gold being found in Wales. Can you inform me in what district and under what conditions it is there met with?—G. S.

Answers to Geologist (Worcester); X.Y.Z. (Dublin); W. S. (Bristol); E. K. J. (Farnborough); E. A. W. (Weston-Super-Mare); X. Y.; A Young Enquirer; Notes by Ερικ; and many others, are in type, but cannot be printed in this number for want of space.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—At the meeting of this society, February 3, 1858, a very important communication was read "On the Succession of Rocks in the Northern Highlands, from the oldest Gneiss, through strata of Cambrian and Lower Silurian age, to the Old Red Sandstone inclusive," by Sir R. I. Murchison, F.R.S., V.P.G.S.

In this paper a general sketch was given of the succession of the stratified rock-masses occupying the northernmost counties of Scotland (Sutherland, Caithness, and Ross), as determined by former observations of Prof. Sedgwick and Sir R. I. Murchison, and by those of Macculloch, Jameson, Cunningham, Miller, and Nicol, as well as by the recent discoveries of Mr. Peach. In the commencement, Sir Roderick, having referred to the long-held opinion that the great mountainous masses of red conglomerate and sandstone of the west coast were detached portions of the Old Red Sandstone, alluded to Mr. C. Peach's discovery (in 1854) of organic remains in the limestone of Durness, which led Sir Roderick to revisit the Highlands, accompanied by Prof. Nicol, when having found more fossils, he expressed his conviction, at the British Association, Glasgow Meeting, 1851, that the quartzites of Sutherland and their subordinate limestones were of Lower Silurian age; and was strengthened in the opinion, which he had already published, that large portions of the crystalline rocks of the Highlands would prove to be the equivalents of Lower Silurian deposits in the south of Scotland. In 1856 Colonel James and Prof. Nicol separately observed the unconformable overlap of the great conglomerates by the quartzite series; and the latter geologist greatly extended all previous observations, and communicated to the Society a memoir, showing that the old gneiss and its superposed conglomerate, as seen along a very extensive region of the western coast, formed the buttresses upon which all the crystalline quartz-rock and limestone of the western parts of Ross-shire and Sutherlandshire reposed. At the same time Prof. Nicol hypothetically suggested, that, until the evidence of fossils was more complete. the quartzite and limestone might be considered as the equivalent of the Carboniferous series of the South of Scotland. Another hypothesis, which had been propounded by the late Mr. Hugh Miller, regarded the quartz-rocks and hard limestones of Sutherland merely as the metamorphosed representatives of the Old Red and Caithness series of the Eastern Coast.

Both of these hypotheses, however, seemed to the author to be quite incompatible with the physical order of the rock-masses in question; for, according to the observations made long ago by Prof. Sedgwick and himself, the above-mentioned crystalline rocks, in the lower part of which the Durness fossils have recently been found, are the inferior members of the great undulating mass of micaceous and schistose rocks, which, rolling over to Caithness on the east, there constitute the basis out of which the bottom strata of the Old Red Sandstone are chiefly formed.

Of late, Mr. Peach has, by his untiring perseverance, obtained a still larger collection of fossils from Durness, and in better preservation than those found in 1854, and Mr. Salter finds that this collection of well-defined forms comprises genera known hitherto only in the Lower Silurian of North America. Hence all doubt is now dispelled; and the author, following up the suggestions which he offered at the Glasgow Meeting of the British Association, describes in the present paper these rocks and their fossils; defining the great unfossiliferous conglomerate-masses of Sutherland as of Cambrian age; the quartzites and limestones as Lower Silurian; and the overlying micaceous and gneissose schists and flagstones as also of Silurian age.

In the body of the memoir, Sir Roderick, after a brief notice of the "fundamental gneiss," described the "Cambrian red sandstone and conglomerate," alluding to the faithful descriptions by Hugh Miller and Nicol. He also detailed certain subsequent observations of Colonel James and Mr. Peach on the unconformity of these rocks to the overlying quartzites, and on the great dislocations exhibited in these masses; and further noticed the discovery of a porphyry between the gneiss and the conglomerate by the latter observer.

The "Lower Silurian rocks, in the form of quartz-rock, crystalline limestone, chloritic and micaceous schists, and younger gneiss," were then described. The fossils from the quartz-rock consist of small annelide tubes now named *Serpulites Macculllochii*, and traces of fucoids. These fossils were long ago noticed, but of late they have been traced in beds for great distances by Mr. Peach. The strong band of limestones between two quartz rocks is estimated by Colonel James to lie about 800 feet above the base of the series, and is of great extent. The fossils detected in it have been determined by Mr. Salter to be *Maclurea Peachii*, spec. nov. (and its curious twisted operculum), *Ophileta compacta*, well known in Canada, *Oncoceras*, spec., and *Orthoceras*, a smooth species with a compressed siphuncle. They all closely resemble fossils of the Lower Silurian rocks of North America, which range from the Calciferous rock up to the Trenton limestone, both inclusive; a group especially to be found in the limestones of the Ottawa River in Canada.

Passing across Ross-shire, in a more southern parallel, from Loch Duich in Kintail, on the west, to the frontier of the Old Red Sandstone on the east, the general succession of rocks was described to be much the same as that in North-west Sutherlandshire, though there are considerable changes of lithological character when the same rocks are followed southwards or south-south-west upon their strike; and the author stated his belief, that not only may the regularly bedded limestones which are intercalated in the chloritic and quartzose rocks of Dumbartonshire be classed with some of the oldest of those stratified masses which, like the limestones of Sutherland, are unquestionably of Lower Silurian age, but that the vast and evidently overlying masses of mica-schist and quartzose-gneissic flag-rocks of the Breadalbane district may be some day found to be simply the prolongations of the micaceous flagstones of the North-western Highlands above alluded to, as overlying the quartz rock and fossiliferous limestone; further, that in the still higher limestones and schists seen on the banks of Loch Tay, we may speculate on the existence of the equivalents of younger and higher strata than any which are observed in the Northern Counties.

After some observations on the truly stratified condition of these micaceous and gneissose schists (younger gneiss) of the Highlands, Sir Roderick proceeded to the consideration of the "Old Red Sandstone of the North east of Scotland;" defining the tripartite division of this great series, and demonstrating that the beds with *Cephalaspis Lyellii* and *Pterygotus Anglicus* of Forfarshire really lie at the base of the series, and are certainly of greater antiquity than the bituminous fossil-bearing schists of Caithness. This division is in accordance with the relations of the deposits of the Devonian period, as seen in Devonshire and Germany; though the lowest member of the Old Red of Scotland has no representative in the Devonian rocks of Russia. The Caithness flagstones were described as being in the middle of the series; whilst the underlying conglomerates and sandstones were shown to be the true equivalents of the Cephalaspis-beds of Forfarshire, and of the lower cornstone-strata of Herefordshire, which there graduate downwards, through the tilestones, into the uppermost Silurian rocks of Ludlow.

The Old Red rocks of the North Highland were described in more or less detail by the author, who showed that the group, as seen in Caithness and the Orkney Islands, is composed of—1st, lower red conglomerate and sandstones; 2nd, grey and dark-coloured flag-stones and schists, both bituminous and calcareous (this portion being in Elginshire and Murrayshire represented by cornstones); and 3rd, upper red sandstones. The North Scottish Old Red contains one great inferior portion which has no representative in the Devonian rocks of some foreign countries, though it is completely represented in all its parts in other tracts both of Britain and the Continent.

Having next described the conditions under which many of the species of fish (at least twenty-one) found fossil in Caithness and Cromarty occur in Russia commingled with the middle Devonian mollusks of Devon, the Boulonnais, and the Rhine; and, having pointed out that the lowest member of the Devonian series, with its *Cephalaspides*, is wanting in Russia, Sir Roderick insisted on the importance of the Devonian series in the scale of formations, and on the fact that the Old Red conglomerates, ichthyolitic schists, and cornstones, with the overlying sandstones of Scotland and Herefordshire, fully represent in time the Devonian rocks of the south of England and the continent, so full of corals, crinoids, and marine mollusks.

Some brief observations on the Newer Red Sandstone of the West Coast of Ross-shire, and the Lias and Oolitic deposits of the North of Scotland and the Western Isles, concluded this paper.

A series of the Fossils from Durness was exhibited in illustration of the memoir, which was also illustrated by a new geological map of the Northern Highlands, and by a large general section across the North of Scotland.

At the meeting, a crystal of transparent calc-spar from Iceland, of unusual size, was exhibited by Prof. Tennant, F.G.S.

On the 19th Feb. (anniversary), Major-General Portlock, the President, read a lucid and comprehensive address, in which, after the obituary notices of late eminent geologists, a masterly exposition was given of geological investigations, the results of which have been published during the past year in the Memoirs of British and Foreign Scientific Societies.

On the 24th, papers on the Mutations of Level were read; namely, on elevations and depressions of land on the eastern coast of Sicily, in Aberdeenshire, and in South Wales.

REVIEWS.

The Ground beneath us: its Geological Phases and Changes. By JOSEPH PRESTWICH, Esq., F.R.S., F.G.S. London: Van Voorst. 1857.

THIS truly excellent pamphlet, which made its appearance at the close of the last year, is the substance of three lectures delivered by the author at the Clapham Athenæum, and contains much valuable matter relating to the London Tertiary and Drift deposits. It ought to be in the hands of every student interested in those later eras of the formation of our world, and the general progress of the science of Geology would be greatly facilitated if every district possessed as accurate and as intelligible a description as that given here of the London area. The author commences with the Post-Pleiocene period, and in his remarks, treats of the origin of the sub-angular flint-gravel; of the sources whence the materials of that curious deposit were derived, how and by what means they were accumulated in their present situations, and of the evidences by which its geological age is determined. The woodcuts throughout the pamphlet are in pure outline, in accordance with the elementary character of the work; and the specimens of sub-angular flint, flint-pebble, and flints containing traces of various familiar fossils of the upper white chalk, have been appropriately selected for the illustration of this portion.

The author afterwards passes to the organic remains of the Drift period, and gives an admirable sketch of that great mammalian era which preceded our own when the mammoth, rhinoceros, and hippopotamus, and herds of gigantic oxen and deer roamed in their wild freedom over our now busy and peaceful land, unmolested except by the carnivorous tigers, hyænas, wolves, and bears that prowled through the forests or lurked in the caves. Figures are given of the teeth of mammoth, rhinoceros, and hyæna, of the horns of deer and ox, and of several species of those delicate marsh-shells, Pupa, Succinea, &c., which are preserved in the same beds.

The second lecture is devoted to the London Clay and its characteristic organic remains.

The denudation of the Thames valley is well explained in the text, and by some clear diagrams and a section; while the characters of the molluscs, reptiles, fish, and plants of the London clay period, and their affinities to recent forms, are carefully considered and well exemplified in the figures given of the chief typical species.

The lower London Tertiaries form the staple of the last lecture, which is, perhaps, the most important of the three for the matter it contains and the manner in which that matter is communicated.

The practical study of the Lower Tertiary deposits of the region around London is at all times difficult to the uninitiated inquirer, and these, more than any of the other groups of strata, require an able expositor in the field—so much is there which may be overlooked, and so much which may be mistaken. Independent, however, of the assistance given to the student by the well-selected specimens of typical fossils and the indications of localities, this lecture is interesting even to the scientific reader, from the lucid manner in which it points out the relations of land and sea during, and the climatal conditions of, the Eocene period. Appended to these lectures are a coloured outline geological map of the neighbourhood of London, and a vertical section on scale of the Drift and London Tertiary strata at Clapham—this latter conveying a most excellent view of the whole series of Tertiary beds, from the gravel down to the thin stratum of green-coated flints below the Thanet Sands, as it rests on the furrowed surface of the chalk.

Outlines of Geology. Edited by T. Allison Readwin, F.G.S. London: Reynolds and Co., 15, Old Broad Street. 1858.

Nothing shows so little, in their completeness, the labour and time of production, as tables or tabular arrangements of special subjects. Such are like the sums total of bills where no items are apparent, no calculations displayed; or like the portrait of a house, in which we observe nothing of the expenditure or workmanship, nothing of the thousands of bricks, the loads of mortar, the timber, iron, paint, and paper; but are only gratified with the result produced. The chief and best feature in Mr. Readwin's "Outlines" is the Table of British Rocks (table No. 3), showing the order and the superposition of the systems, formations, and strata into which the various mineral masses have been arranged by Geologists. Concise, accurate, and well arranged, it is easily understood; and its lessons may be safely remembered, because they are true according to the present determinations of the science.

The attempt to indicate the minerals of each deposit is novel, and although only partially successful, is to be highly commended as a step in the right direction.

It is necessary now to know something of Geology. One cannot pass muster in cultivated society without at least that amount of elementary knowledge which may here be procured for a shilling.

Geology and Genesis. By C. London: Whittaker and Co. 1857.

This book has resulted from the controversy between Dr. Baylee and "C.," carried on in the columns of the daily *Post*, in January and February last year, and bears on its title-page the aphorism of Bacon, *Vere scire est per causas scire.* We confess to have, in general, little affection for any sort of controversies: they generally lead to ill-will; and such points as that which forms the subject of this production, more than any other, require the utmost amount of special knowledge and mutual forbearance and good-will.

An old adage says that in all quarrels there is always something wrong on both sides, and we must say that we agree with neither one party nor the other in this dispute. We consider them both, to some extent, wrong, and that recourse must still be had to the *facts* to understand well, or at all, either the harmony or the imputed discordance between Genesis and Geology. Some knotty points are ingeniously treated in these pages; but, as might have been expected, there seems manifested a strong desire, on either side, to acquire a victory.

To all who attempt this subject we would say, Study your Bible and study Geology in the full faith that truth will never be antagonistic to truth—and then judge for yourselves.

The book, although insufficient in the settlement of this much-vexed question, is by no means without use as a text-book or as a store of quotations and of ideas relating to the literature and hypotheses of Cosmogony.

REYNOLDS' OUTLINES OF SCIENCE AND ART.

A TABULAR VIEW OF THE ARRANGEMENT OF BRITISH ROCKS.

Shewing the Order of Superposition, and the Characteristic Rocks, Minerals, and Fossils, with References to the Fossil-Cases at the

MUSEUM OF PRACTICAL GEOLOGY.

Entered at Stationers' Hall.]

PRICE SIX-PENCE.

[*Edited by* T. ALLISON READWIN, F.G.S.
12*th January*, 1858.

	GEOLOGY.			MINERALOGY.	PALÆONTOLOGY.	
Systems.	**Formations.**	**Strata.**	**Characteristic Rocks.**	**Characteristic Minerals.**	**Characteristic Fossils.**	
POST-TERTIARY	Modern	Surface Deposits—*Alluvium*	Soil, Clay, Silt, Sand, Gravel, Peat-Moss, Loam	Calc-tuff, Bog Iron, Phosphate of Iron, Amber	First *Human Remains*	Upper Gallery
CAINOZOIC	Pleistocene	Glacial or Boulder Drift and Gravel	Drift or Boulder Clay, Shell-Marl, Pebbles, Shingle, Boulders	Common Oxide of Iron, Calc-Nodules, in Brick-earth	Fossils chiefly *existing*, Extinct Mammalia	49 to 51.
(UPPER)	Pliocene *	Mammaliferous, or Norwich Crag	Shelly Beds of Sand, Clay & Loam, layers of Shingle & Gravel	Disseminated Oxide of Iron, Phosphatic Nodules	Mastodon, Elephant, Birds, Bryozoa	52.
		Red Crag of Norfolk and Suffolk	Ferruginous shelly Sand & Loam		Bones & Teeth of Fishes, many Marine Shells	
		Coralline Crag of Suffolk	White calcareous shelly Sand, Flaggy Limestone	Oxide of Iron	Corals, Zoophytes, Echinodermata, Shells	
TERTIARY. (LOWER)	Eocene „ (upper)	Hempstead Series	Marine and Freshwater Sands and Clays	Lignites, Ironstone, Iron Pyrites	Fluvio-Marine Shells and Plants	
		Bembridge Series	Marine and Freshwater Limestones, Marls and Clays	Gypsum, Flint, Calc-Spar, Oxide of Iron	Marine Shells, Turtles, Palæotherium	
		Headon, St. Helen's & Osborne Series	Marine and Freshwater Organic Beds, alternating	Lignites, Glass-house Sand, Ironstone	Marine Mollusca.	
		Upper Bagshot Sands	Fossiliferous Sands and Clays	Oxide of Iron	Marine Mollusca and Plants	
	„ (middle)	Barton Clay (Middle Bagshot)	Marine Sands and Clays, layers of Septaria	Iron Pyrites, Carbonate of Iron, Gypsum, Lignite	Marine Shells, Nummulites	53 to 58.
		Bracklesham Sands (Middle Bagshot)	Marine Sands Clays and Marls	Oxide of Iron, Flint, cemented by Iron	Marine Mollusca, Dicotyledonous Plants	
		Lower Bagshot Sands	Sands, Sandstones and Foliated Marls	Oxide and Sulphate of Iron, Lignite, Selenite	Marine Plants	
	„ (lower)	London Clay (Bognor Series)	Brown and Bluish-gray Clay, with layers of Septaria	Sulphide and Carb. of Iron; Septaria, Selenite	Marine Shells, Fishes, Reptiles & Saurians.	
		Plastic Clay (Woolwich-Reading Ser.)	Sand, Mottled Clays, and rolled Flints from the Chalk	Sulphide and Carbonate of Iron; Allophane	Mammalia, Reptiles, Marine Mollusca.	
		Thanet Sands	Sands, with a few concretionary masses of Sandstone	Oxide of Iron, occasionally	Marine Mollusca.	
MESOZOIC.	Cretaceous (upper)	Upper Chalk	Soft white Chalk, Beds and Nodules of Flints and Chert	Flint, Iron Pyrites, Chert	Marine Shells, Echinodermata, Sponges.	
		Lower Chalk	Hard Chalk, less white, generally without Flints	Iron Pyrites, Ochreous concretions	Sponges, Cephalopoda, Foraminifera.	
		Chalk Marl	Soft grey Chalk, very clayey, sometimes indurated	Phosphate of Lime (Coprolites)	Shells, Echinodermata.	
(UPPER)	„ (lower)	Upper Green Sand	Siliceous and Calcareous Sand, Nodules of Chert	Siliceous concretions, Firestone, Allophane	Ammonites, Corals, Cephalopoda	28 to 30.
		Gault	Bluish tenacious Marly Clay, green grains, layers green sand	Phosphate of Lime (Coprolites), Pyrites, Selenite	Marine Shells, Belemnites, Ammonites.	
		Lower Green Sand	Green or Ferruginous Sands, layers of Cherty Limestone	Ironstone, Fuller's Earth, Kentish Rag	Marine Shells, Cephalopoda, Crustacea.	
	Wealden	Weald Clay	Blue and brown strong Clay, with beds of shelly Limestone	Petworth or Sussex Marble, Carb. Lime, Calc-Spar	Reptiles (Iguanodon), Fishes, Plants	25 to 27.
		Hastings Sands	White, yellow, and green Iron-Sands, Friable Sandstone	Ironstone, Lignite	Reptiles, Plants (Coniferæ), River Shells	
	(*Jurassic*) Oolitic (upper)	Purbeck Limestones	Estuary Limestones, alternating with Sands and Clays	Calc-Spar, Limestone, Marble	Fishes, Mammalia, Insects, large Reptiles.	
		Portland Oolite and Sand	Oolitic and shelly Limestone, layers of Chert and Sand	Chert, Calc-Spar, Quartz-Crystals, Lignite	Insects, Marine Shells, Lizards, Trees	
		Kimmeridge Clay	Dark blue or black slaty Clay, Bituminous Shale	Bitumen, Gypsum, Lignite, Iron Pyrites, Alum	Marine Shells, Ammonites, Belemnites.	
		Upper Calcareous Grit	Sands, Beds and Nodules of Calcareous Grits	Calc-Spar	Ammonites, Corals, Marine Shells	
	„ (middle)	Coral Rag	Coarse Oolitic Limestone, with abundance of Corals	Calc-Spar, Silica	Corals, Marine Shells.	
		Lower Calcareous Grit	Sands, Beds and Nodules of Calcareous Grit	Calc-Spar	Ammonites, Corals.	
		Oxford Clay	Dark blue Clay, slaty and bituminous	Selenite, Iron Pyrites	Fishes, Shells, Belemnites, Ammonites.	
		Kelloway Rock	Ferruginous coarse Calcareo-Siliceous Limestone	Oxide of Iron, Calc-Spar	Marine Shells, Ammonites, Belemnites.	
SECONDARY. (LOWER)	„ (lower).	Cornbrash	Coarse rubbly Limestone, Layers of Clay, &c	Oxide of Iron, Calc-Spar	Marine Shells, Ammonites	8 to 25.
		Forest Marble	Laminated shelly Limestone and Grits, with layers of clay.	Shelly Marbles and Drift-wood	Marine Shells, Drifted Wood, &c.	
		Bradford Clay	Layers of grayish tough Clay, with bands of Limestone	Calc-Spar, Fuller's Earth	Marine Shells, Encrinites	
		Bath, or Great Oolite	Thick bedded Oolitic Limestone, Freestone	Roe-stone, Pisolite	Corals, Shells, Nautili, Ammonites.	
		Stonesfield Slate	Oolitic shelly siliceous Limestone, slaty	Pyritous Coal, Oolitic Roofing Slate	Reptiles, *Mammalia*, Pterodactyli.	
		Fuller's Earth Rock, and Clay	Limestone and Clay, containing Fuller's Earth	Fuller's Earth, Gypsum	Marine Shells, Echinodermata.	
		Inferior Oolite	Coarse shelly Limestone or Freestone	Calc-Spar, Oxide of Iron, Iron Ore, Lead Ore	Marine Shells, Terebratula, Echinodermata.	
	Liassic	Upper Lias Shale, Clays, and Sands	Dark blue Clay, Alum Shale, Ferruginous Sand	Bitumen, Alum, Jet, Lead Ore	Marine Shells, Fishes, Saurians.	
		Middle Lias Marlstone	Calcareous laminated sandy Limestone, Iron Beds, Septaria.	Nodules of Ironstone, Septaria	Marine Shells, Ammonites, Belemnites.	
		Lower Lias Shale and Bone Bed	Dark blue Shales and Limestone, alternating	Bitumen, Iron Pyrites, Phosphate of Lime	Saurians, Cephalopoda, *First Mammalia*	
	Triassic Keuper	Variegated Marls	Red, blue, and green Marls, Sandstones and Shales	Gypsum, Rock Salt	Few fossils discovered. *Foot-prints.*	Lower Gallery 39.
		Red Clays	Red Clays and Marls	Agates, Gypsum, Oxide of Iron		
		Conglom. & Sandstones (Waterstones)	Red and white salty Sandstone, Conglomerates			
	† Bunter	Red and Mottled Sandstones	Red Clays and Sands with Gypsum	Oxide of Iron	Fish remains rare, Plants (Calamites).	10
		Conglomerates	Conglomerates and Breccias	Oxide of Iron		
		Red and Mottled Sandstones	Indurated ferruginous Sandstones	Oxide of Iron		
PALÆOZOIC.	Permian	Magnesian Limestone	Fawn Colored Magnesian Limestone, sometimes brecciated	Ores of Lead and Copper	Marine Mollusca.	40
		Lower New Red Sandstone and Marl	Sandstones and Clay-Marls interstratified	Oxide of Iron, Gypsum, Agates	Coniferous Wood.	
		Conglomerates and Breccia	Conglomerates and Breccia-Beds	Oxide of Iron, Gypsum	No fossils yet discovered.	
(UPPER)		Red Sandstone and Marl	Highly ferruginous Sands and Marls	Oxide of Iron	Marine Remains	
	Carboniferous	Coal-Measures	Coal-beds with layers of Shale, or Grit.	Anthracite, Splint, and Cannel Coal, Ironstone	Mar. & Freshw. Mollusca, Ferns and Palms	32 to 38.
		Millstone Grit	Siliceous Sandstones and Conglomerates	Coal, Ironstone, Fireclay	Plants and Marine Mollusca.	
		Carboniferous or Mountain Limestone	Compact or Crystalline Limestone and Shales	Fluor, Ores of Lead, Zinc, Antimony, Iron, Cobalt	Marine Shells, Zoophytes, Corals	
PRIMARY.	Devonian or Old Red	Upper Devonian Petherwin Limestone	Shales and Limestones alternating	Agates, Ores of Tin and Copper	Corals, Brachiopoda.	28 to 31
		Middle Devonian Limestone & Cornstone	Sandstone, with Limestone and Cornstone	Peroxide of Iron, Jasper, Agates, Carbonate of Lime	Corals, Brachiopoda	
		Lower Devonian Sandstone & Tilestone	Sandstones, Shales and Limestones	Firestone, Calcedony, Ores of Copper and Tin	Marine Mollusca	
(LOWER)	Silurian „ (upper)	Upper Ludlow Shale	Indurated shaley micaceous Sandstones		Mollusca, Brachiopoda, Graptolites.	17 to 27
		Aymestry Limestone	Impure Crystalline Limestone	Calc-Spar	Marine Mollusca, Corals.	
		Lower Ludlow Shale	Indurated shaley micaceous Limestone		Marine Mollusca, Trilobites	
		Wenlock Limestone	Gray Limestone, Clayey Shale in thick beds	Calc-Spar	Brachiopoda, Encrinites, Bryozoa.	
		Woolhope Limestone and Shale	Crystalline Limestones and Shales alternating	Calc-Spar	Corals, Trilobites, Graptolites.	
		Denbighshire Grits	Coarse Siliceous Sandstones		Marine Mollusca.	
		Upper Llandovery Rock	Fine grained Sandstones and Conglomerates	Peroxide of Iron	Marine Shells, Corals, Trilobites.	
	„ (lower)	Lower Llandovery Rock	Green and purple Sandstones and Shales	Peroxide of Iron	Marine Shells, Corals, Trilobites.	12 to 16
		Caradoc or Bala Sandstones, & Flags	Shales and Sandstones	Ores of Lead, Copper, and Iron	Corals, Trilobites, Brachiopoda	
		Llandeilo Flags	Black laminated Flagstones and Limestones	Ores of Lead, Copper, and Iron	Trilobites, Brachiopoda, Graptolites	
		Graptolite Schists	Black Schists	Ores of Lead, Copper, and Iron	Graptolites, Brachiopoda.	
		Lingula Flags	Black Schists and dark gray Flagstones	Ores of Lead, Copper, Gold, Silver, Zinc	Brachiopoda, Trilobites.	
	Cambrian	Harlech, Llanberis, & Longmynd Grits	Conglomerates, Sandstones, Shales and Slates	Sulph. of Baryta, Ores of Copper, Gold, Silver, Lead	Fucoids, Zoophytes	12.
AZOIC.	Metamorphic	Gneiss, &c., rudely stratified	Clay-Slate, Gneiss, Quartzite, Hornblende, Serpentine.	Marbles, Garnets, Asbestos, Ores of Tin, Lead, Cop.	No Fossils yet discovered.	Up. Gal. 2 to 7
	Igneous	Granite, &c., unstratified	Granite, Serpentine, Porphyry, Syenite, Basalt, Trachyte	Quartz, Felspar, Mica, Talc, Ores of Tin, Lead, Cop.	No Fossils yet discovered.	

* The *Miocene*, and † *Muschelkalk* Formations, are not inserted, as they are *wanting* in Great Britain.

N.B.—The *Numbers* in this Table refer to the *Wall-Cases* in the Galleries of the MUSEUM OF PRACTICAL GEOLOGY, Jermyn Street, where the Fossils are stratigraphically arranged.
The *Table-Cases* in the Lower Gallery contain Mollusca and Trilobites up to the *Permian* Formation; and those in the Upper Gallery contain Mollusca, from the *Liassic* Formation upwards.

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THE GEOLOGIST.

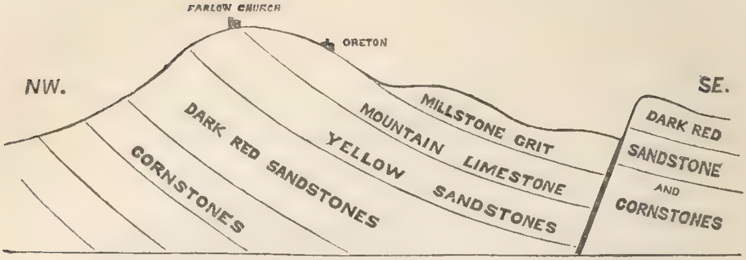
APRIL, 1858.

ON THE LOWER CARBONIFEROUS BEDS OF THE CLEE HILLS.

By George E. Roberts, Esq., of Kidderminster,
Member of the "Worcestershire Naturalist Field Club," &c.

Perhaps in all the physical geology of England there is nothing finer than the erupted heights of the Clee. Encircled by the typical "Old Red"—a wide-stretching tract of alternating sandy shores and gravel-beaches of that period—are the characteristic beds of the coal-measures, lying upon Millstone Grit and Mountain Limestone.

Of the causes that have elevated these deposits into the hills of Titterstone and the Brown Clee I need not speak—their basaltic summits, where the erupted rock has assumed a rude columnar form after cooling, are sufficient evidence; but I would direct especial attention to that group of beds whose strike is along the Oreton ridge, and whose chief member, the Mountain Limestone, forms its axial line. This lies midway between the two hills; its southern side slopes down the "Common," and is composed of Millstone Grit, cut off abruptly by a long line of fault, the effect of which has been to have depressed that deposit into a valley, and to have raised the underlying "Old Red" into a nearly continuous line of cliff. The accompanying section will better describe their relative positions.



Section of the Clee Hills at Oreton.

These Millstone Grits are non-fossiliferous; but the mineralogist may detect in their conglomerated structure many pebbles of a high class, jaspers and cornelians of pure quality being often met with. These beds lead up to the Mountain Limestone, which contains a fine series of organic remains, such as palatal teeth of the Cestraciont fishes. Petalodus Hastingsii and Psammodus porosus are abundant; yet, although fragments of their jaws are not uncommon, I have only met with one specimen having the teeth in their true position. Shells and corals are plentiful, but limited in species, only the most typical being found. The Crinoids are well represented in the fragmentalia—one bed lying low down upon the yellow sandstone is little else than a mass of detached ossicula and pelvic plates, which are nearly all referable to one genus, Cyathocrinus.

The ridge is boldly quarried; in two cases the excavations pass through its back-bone of Mountain Limestone to the underlying yellow sandstones, and these spots I would especially recommend to the geologist who wishes to work out the animal contents of those particular strata. The rugged masses that are broken up for the kilns are wearisome to work and nearly devoid of fossils. The easternmost quarry on the ridge, where the beds are most vertical in their dip, I would also specially recommend; for in the yellow sandstone there exposed I have recently obtained some interesting remains of Pterichthys, consisting of plates of the back and, what are even more easy to make out, their curiously-shaped tails. These are new to English beds. With these I have found scales of *Holoptychius nobillisimus*, *H. giganteus*, and a detached jaw-tooth of *H. Hibbertii* (?) The fine head of Pterichthys, a new species, according to Sir P. Egerton, discovered by Mr. Baxter, of Worcester, was obtained from a quarry at Farlow, a mile from this one, and quite as well worthy of a visit. Two quarries have there been opened to supply building-stone for a church; one at such an interesting horizon, that a slab of rock I procured from it has an upper surface of Mountain Limestone with *Spirifera* and a palatal tooth of Psammodus three inches in length, while upon the under-surface of yellow sandstone are seen the white scale-plates of Holoptychius.

The other quarry, below the church, should also be examined carefully, for this yellow sandstone is the equivalent of the Dura Den beds of Fife, and of certain beds exposed along the western side of the Forest of Dean coal-fields. Here I again detected the white china-looking plates of Pterichthys, but no other fossils of importance.

Detached pebbles of quartz are distributed throughout this bed; while the surfaces of the slabs are beautifully furrowed with the ancient ripple-marks.

Beneath these beds, stretching far away, twelve miles to the northward, lie those persistent beds of "dull brick-red" sandstone and cornstones, which seem to be the natural base of the great carboniferous formation.

There are no lower beds than these exposed until the geologist has travelled westward to the escarpment which bounds the lovely "Dale" of the Corve, where a line of Upper Tilestones is exposed, upon which the cornstones unconformably repose. Plates of Asterolepis are not uncommon in the cornstones, but rarely in fine condition.

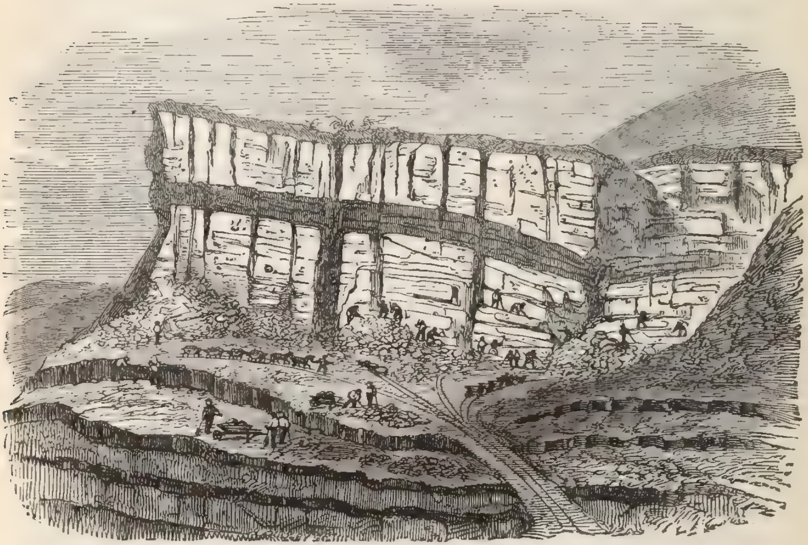
To conclude this brief sketch, I would add that the geologist who may contemplate a visit to the Clee would be greatly benefited in his pursuit if he could obtain permission to inspect the fine suite of fossils and rock-specimens collected by W. W. Jones, Esq., of Cleobury Mortimer, before doing so. This gentleman's collection has been of important service to myself in working up the district; and, while I am pleased to have the opportunity of acknowledging the courtesy I received at his hands, I feel he would be pleased to give similar facilities to any true geologist interested in the study of the rocks of this locality.

ON THE GEOLOGY OF THE BEAUFORT AND EBBW VALE DISTRICT OF THE SOUTH WALES COAL-FIELD.

By George Phillips Bevan, Esq., M.D., F.G.S.

(*Continued from page* 54.)

In my former paper I endeavoured to describe the general appearance and characteristics of the limestone, millstone grit, and Pennant rocks of this coal-field, and shall now proceed to give a brief outline of the coal measures themselves and their fossil contents. As I stated before, the character of the coal is materially different in different parts of the basin; for instance, if a line be drawn from Merthyr to the sea in a south-western direction, it will divide the basin into two unequal portions, the eastern one containing bituminous coal, and the western the anthracite. I do not mean to say that there is an exact line of demarcation between the two kinds of coal, but merely that such a boundary will seem to show pretty well where the two qualities pass into one another. Curiously enough, too, in the western or anthracite portion the seams are anthracitic in the northern bassets, while the southern outcrops of the same veins are bituminous. The anthracite is now in very great demand; but, formerly, people would have nothing to do with it, and there was even a law passed to prevent its being burned in London, on account of its supposed noxious qualities, and the idea that it was detrimental to health. It differs from the bituminous coal principally in containing more carbon, less bituminous matter, and less ashes; and, as a consequence, is a much cleaner-burning coal. We may, however, dismiss the anthracite, as this portion of the field is destitute of it. As will be seen in the section appended further on, there are, in this district, about thirty seams of coal of greater or less thickness, and as many courses or bands of ironstone. Before entering, however, on the sections and their contents, it would be as well to describe briefly the mode of working the various seams. Now, in a flat country, such as in the Staffordshire coal-field, the coal is obtained by the sinking of a shaft or pit. This is the most usual way, and one which is largely practiced in South Wales. As the seams generally run rather closely and compactly together, a shaft sunk to the bottom will, of course, traverse them all. Steam-engines of great power are for the most part used, both for bringing up the coal and iron, as well as for pumping. When, however, the pit is situated so as to command a large quantity of water-power, this is used instead of steam, and thus: a large moveable cistern, having an iron plate across it so as to hold an empty tram, is filled with water at the top of one shaft, a corresponding empty cistern is at the bottom of the other shaft, with a loaded tram upon it, which is brought up to the surface as the full cistern descends. This is termed a balance pit, and, of course, saves a large outlay in buildings, engines, and machinery. Besides pit working, there is, in South Wales, a very common way of getting at the coal, which can only be practiced in a hilly country, and this is by working a level. When a vein of coal is known to occupy a certain position in a hill, it is easier, instead of sinking a pit *down* upon it, to pierce *through* the hill until the vein is reached, just as one may see a long culvert under a railway embankment. This, of course, is a comparatively inexpensive way of working, because the only material requisite for the level are supports for the roof, and a tramway underneath, and it has the advantage of allowing men and horses to walk in and out to their work. The number of miles laid down underground is surprising, and the excavations ramify so extensively that the ground is perfectly honeycombed, and it often requires care, even for a collier, to avoid losing his way in these labyrinths. The third way of working is the simplest of all, and is called patch-working. It is nothing more nor less than digging down from the surface upon the seam of coal or iron, which of course is not practicable when the vein crops out. It is, in fact, a quarry—but such a quarry—where you stand upon a floor of coal, and can see by Heaven's light the manner in which the veins lie upon each other. I have endeavoured to delineate a fine example of patch-working at a place called the Elled Patch, which is situated on the shoulder of the hill between Nantyglo and Beaufort. From the turnpike-road it presents the appearance of a large escarpment, ever altering in appearance and proportions. The topmost thin layer is one of surface soil and stones, beneath which is a considerable thickness of hard sandstone. The shaded part next below consists of dark ironstone, but not of very good quality; while the rest of the thickness, down to where the trams are seen, is ferruginous hard shale, that is a perfect "find" in the way of ferns, to which I shall again allude. In this shale are detached "balls" of mine—in other words, lumps of iron ore, very rich, and in shape somewhat like quartern loaves. These layers are bedded with a certain degree of regularity, and it is to obtain them that the rock and rubbish are so energetically pulled down. "Balls of mine" is a very common term when speaking of iron ore *in situ*, as also are the terms "bands," "corners," and "pins." The next layer, seen in the sketch rather in advance, is one of coal, viz., the Elled coal, about 3 feet 5 inches in thickness, and of very good quality. Below this, again, we see two other thin seams of coal, separated from each other by a considerable thickness of carbonaceous shale, usually called "partings." I hope that this sketch will furnish the reader with a tolerably good idea how the coal and iron run.



The Elled Patch, Beaufort, South Wales.

EXPLANATION.

1. The first narrow band from the top consists of surface soil, &c.
2. Next is hard sandstone.
3. The thin shaded layer is dark ironstone, not of such good quality as that in the next layer (4). This is of great thickness, and consists of shale more or less hard, the heaps of which are shown at the bottom. On these shale slates are the fern impressions. The little detatched markings are balls of rich ironstone.

5 Is the Elled vein of coal, about 3 feet 5 inches thick.

6 Is a smaller vein worked below it.

7 Is the parting of clunch or rubbish between the veins. The hills to the right and left in the distance consist of Pennant sandstone.

The following is the section of the strata in the valley of the Ebbw—the whole comprising a thickness of about 470 yards:—

	ft.	in.
Trod-y-rhiw coal[*]	2	4
Underclay		
Sandstone and shale, with thin seams of coal and underclay		
Coal	1	6
Carbonaceous shale		
Sandstone		
Carbonaceous shale		
Sandstone		
Carbonaceous shale		
Coal	1	2
Underclay		
Coal	0	10
Shale, containing seams of coal		
Argillaceous shale, with "Upper Pins"		
Old Man's coal	2	4
Underclay		
Black Band		
Sandstone and shale		
Coal	2	0
Sandstone and shale		
Argil. shale, with ironstone		
Shale, with "Soap veins" (ironstone)		
Carb. shale, with black band		
Coal	1	6
Sandstone		
* Shale, containing "Black Pins" (ironstone)		
Coal	0	4
Argillaceous shale		
Fireclay		
Shale and sandstone		
Carb. sh., with ironst. nodules		
*Elled coal	3	4
Coal, with shale partings	1	6
Big Vein coal, with partings	4	9
Shale with ironstone nodules		
*Three-quarter coal	3	4
Argillaceous shale		
Coal, with partings	1	3
Argillaceous shale, with band of ironstone		
Coal	0	6
Underclay		
Coal	0	8½
Shale and underclay		
Argil. shale, with nodules of ironstone		
Coal	0	7
Coal	0	11
*Arenaceous shale		
Bydyllog coal	3	9
Underclay, with ironstone		
Argillaceous shale		
*Upper Darren coal	0	10
Underclay		
Sandstone		
Argil. shale, with ironstone		
Engine Coal, with partings	5	9
Carb. shale, with ironstone		
Gloin goch bach coal	1	6
Underclay, with ironstone		
Argil. shale, with ironstone		
Coal	1	2
Underclay		
Yard Coal	3	2
*Carb. shale, with black band		
Old Coal	5	6
Sandstone		
Argil. shale, with spotted ironstone		
Coal	0	5
Underclay		
Argil. shale, in red vein (ironstone)		
*Ditto with spotted, and black pins (Ironstone)		
*Big veined ironstone		
Argillaceous shale		
*Bottom vein ironstone		
Bottom vein coal	2	0
Underclay		

The veins marked with a star are those in which any fossil remains have been found. In the first, or Black Pins, there are two or three species of unio or anthracosia.

The Elled is very profitable for the collector of fossils, and I annex a list of the ferns I have found there. They are in extremely good preservation, and well marked; and are met with in the rubbish just over the coal. There are some curious circumstances connected with these ferns; they are exceedingly uncertain in their whereabouts, and were very much more abundant when the workings were first begun than they are now. Sometimes the workmen would come upon a large quantity of one sort, such as Pecopteris Mantelli, which would then utterly disappear, and would not be found again. From the fact of several Sigillariæ being found in erect position, I at first inclined to the opinion that the ferns were in the same place on which they grew; but on a fuller consideration of the matter, I now think, with Professor Melville, that this is a drift formation. I have obtained here, with the help of two very intelligent miners named Davis and Hart, who appear as much interested in the geological facts as myself, the following specimens:—

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[*] By an error in my last paper I stated that this seam of coal belonged to the Pennant rock; but it is at the base of it.

Annularia brevifolia
Asterophyllites foliosus
,, Parkinsoni
,, longifolius
Calamites approximatus
,, cannæformis
,, Suckowii
Fructification of an Equisitaceous plant
Hippurites longifolius
Knorria imbricata
Lepidodendron crenatum
,, elegans
,, minus
,, obovatum
,, Sternbergii
,, plumarum
Lepidostrobus
Neuropteris acuminata
,, gigantea
,, heterophylla
,, macrophylla
Pecopteris adiantoides
,, dentata
,, denticulata
Pecopteris dilatata
,, Cistii
,, caudata
,, laciniata
,, Mantelli
,, nervosa
,, repanda
,, serra
,, Stuttgardiensis
,, urophylla
Pinnularia capillacea
Pterophyllum
Sigillaria flexuosa
,, oculata
,, pachyderma
,, reniformis
,, tesselata
Stigmaria
Sphenopteris affinis
,, caudata
,, dilatata
,, elegans
,, latifolia
,, macilenta

In the three-quarter coal a shell, (a terebratula, I believe,) has been found by my friend Mr. Adams, also a shell in the Bydyllog coal.

The upper Darren coal and mine shale possesses two species of small Unios and an Avicula. The black band over the old coal has furnished us with a large Anthracosia and a small shell like a Nucula, also the scales of Holoptychius. The spotted and black pins have the Anthracosia agrestis and Microconchus carbonarius, while the bottom vein is very prolific in scales (carved and enamelled), teeth, jaws, opercular scales, bones, skin, rays and ichthyodorulites of fishes belonging to the species Holoptychius, Cœlacanthus, Ctenacanthus, Amblypterus and Palæoniscus. In my first paper I mentioned some small coal seams in the millstone grit. They are scarcely worth working, but they are all very rich in fossil remains. From these seams I have extracted Productus, Leptæna, Lingula mytiloides, Turritella, Conularia quadrilineata, Modiola, and a small Orthoceras. From the small "pins" of ironstone and the ferruginous clay there are several varieties of

Productus
Rhynchonella
Leptæna
Terebratula
Spirifer
Strophomena
Lingula
Orthis
Donax ?
Nucula
Pecten
Mytilus
Modiola
Unio
Bellerophon
Nautilus
Murchisonia
Littorina
Goniatites
Turritella

Professor Melville has kindly promised to name all my shells more accurately, for which purpose he has my collection with him in Ireland, so that I am only enabled to lay a very general list before my readers. I trust, however, that a more extended search will be made throughout the whole of this very interesting field, and I feel assured that nobody will be loser by devoting a little time in the patient investigation of this subject.

THE PRACTICAL APPLICATION OF GEOLOGY IN COAL-SEEKING.

By James Buckman, F.G.S., F.L.S., F.S.A.,
Professor of Natural History in the Royal Agricultural College of Cirencester.

Searching for coal is, not only at home but also abroad, a serious subject, and one in which the practical utility of connecting geological knowledge with active operations is particularly obvious, and which from actual experience I can well illustrate by many interesting cases which have come under my own notice. The first determinations in a coal "adventure" may be classified as follows:—

1. *Where coal is not.* 2. *Where coal may be, but at too great a depth for working.* 3. *Where coal may be found convenient for working.* 4. *Its quality and extent.*

In order to make what follows the more interesting, we may premise, what every Geologist now knows—that the earth is made up of strata of different kinds—*e.g.*, sandstones, limestones, and argillaceous beds called rocks. The different strata have been formed step by step, layer upon layer. Each stratum has its distinct position and age in relation to other strata. The relative age and, consequently, position of a rock can be distinguished by mineral structure, fossil contents, or both.

Again, by way of still more clearly establishing our primary position, let the following table represent some of the strata above and below the general coal deposit :—

GROUP.	ROCKS.	PROBABLE THICKNESS.
Oolitic	Upper Middle Lower	1,800 feet.
Liassic		1,200 feet.
Triassic	Keuper Marls New Red Sandstone	1,500 feet.
Permian	Magnesian Limestone Lower New Red	500 feet.
Coal Measures		5,000 feet.
Mountain Limestone.		
Old Red Sandstone.		
Silurian Strata.		

Now this partial table of British strata represents the coal measures as being overlaid by the New Red Sandstone deposits, and underlaid by the Mountain Limestone and Old Red Sandstone, which, though a general, is by no means the invariable rule in coal deposits, as sometimes the Mountain Limestone is absent, and the coal measures rest upon the old red system, as in great part of the Shropshire coal-field. In others even the Old Red is absent, and they repose directly upon the Silurian rocks, as in most part of the Staffordshire basin. Still, inasmuch as the Mountain Limestone is the normal stratum upon which coal rests, we may pronounce it as a fact that this limestone is older than the coal itself; and so confidently assert that boring for coal will be a fruitless operation if attempted from Mountain Limestone, or any other underlying formation. The reason, therefore, why coal may rest upon any other rock older than itself arises simply from the absence of intermediate strata, which so far has interfered with the sequence but not the order of super-position of coal and the deposits below : and the same fact applies to the rock above, the roof of the coal. This, in proper order, will be the New Red Sandstone; and though this rock may be absent, and newer deposits take its place, still the true coal deposits* are not found above the New Red Sandstone; so that in reality the table of strata, as now understood, represents rocks of different ages, each having its own established and relative position.

From these considerations, then, it will be seen that it is often easier to decide where coal is not than where it is—for as rocks of all ages rise to the surface, or "crop out," as the miner terms it, we may, in such case, readily determine, even in a coal country, at least a limit to our search in one direction.

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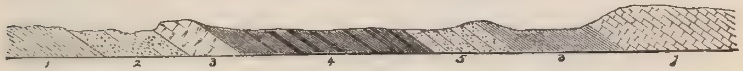

1. Silurian. 2. Old Red Sandstone. 3. Mountain Limestone. 4. Coal. 5. New Red Sandstone. 6. Lias. 7. Oolites.

Here we see that, as older beds crop out to the west, from beneath the coal measures, it would be in vain to seek for coal in that direction; so, in like manner, any well-done geological map of a district or a country would give us distinct information on this point—for wherever beds older than coal form the substratum it would be utter folly to mine in them with the hope of finding coal. It was precisely upon these principles that the geological surveyors of the state of New York, North America, decided that this large State was without coal, and thus put a stop to the wildest speculations, both theoretical and practical, upon the subject, which had been the causes of so many miserable failures.

In our own country how many trials have been made for coal in rocks older than that deposit? In that magnificent work, "The Silurian System," by Sir R. I. Murchison, accounts are given of no less than eight attempts to reach coal from Silurian rocks—sanguine speculators being deceived by dark-coloured shales, a slight deposit of carburet of iron, plumbago, or, as in one instance, a little real anthracite. One of these is worth quoting:—

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* Of course we are aware of coal deposits in the Oolitic and even in the Tertiary rocks, but these are usually unproductive.

"The manner of boring for coal through these ancient rocks (the Silurian), of which many other examples are cited in this work, has unfortunately affected some of the inhabitants of this tract. At Mathon Lodge (Malvern), in 1832, I found open shafts which had been sunk to a depth of about 120 *yards* in the Lower Ludlow rock, where it ought to have been apparent to any one, however ignorant of geological phenomena, that the limestone of the adjacent ridge of Croft Farm and Castle Copse must, by its inclination, be carried beneath this very shale. This, as well as other absurd trials in the incoherent shale of the 'Silurian System,' whenever it happens to be black, has been caused entirely by the lithological and mineral character of the rock, which in truth does not differ very materially to an unpractised eye from the shales of the coal measures."—*Silurian System, p.* 411.

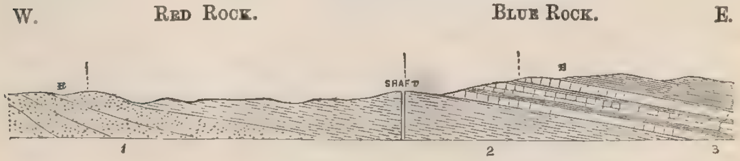
I have hitherto been considering cases in which there can be no doubt that coal must be entirely absent; and hence where speculation must be perfectly hopeless. I shall now, however, call attention to circumstances of a different nature—where there seems every reason to believe that coal is below the district to be examined, but at so great a depth as to render it practically beyond reach. Some two or three such cases, and the facts connected with them, I shall now give, in the order in which they occurred in cases within my own experience. The first was about four miles to the east of the borough of Droitwich, in Worcestershire, where mining operations were commenced at the instigation of a gentleman who had bought an estate in the district, mainly, as I thought, from a belief that the prevalent tradition of "coal having been found there many years ago" was founded on fact. Having secured his purchase, the first thing he did was—not to obtain the opinion of a geologist, but to send into Staffordshire for a "practical miner," with whose report he was so satisfied as at once to commence boring, as a preliminary step to the sinking of a shaft.

The boring went on from day to day as rapidly as such operations can be accomplished, and each day the report to the proprietor was, that they were nearer the coal—until, from about the depth of 150 yards, some coal was absolutely brought to the surface. This was tested—it was indeed coal, and burnt well, which is not to be wondered at when it is considered that it was a portion of Staffordshire coal, which had been put down by a dishonest workman. However, this fraud not being then discovered, it acted as a stimulus to the proprietor, and the din and bustle of a mining district were begun in real earnest, upsetting, by vain expectations, the usual quiet of the village. A slight shaft was then made, from which the borings went on to the depth of 100 yards, at which point the proprietor was advised by a friend to consult a geologist, and I was chosen to undertake the inquiry. I accordingly went to the spot, and shall now state the structure of the strata in the neighbourhood.

On the estate where the works were then proceeding, I soon found that all the higher points presented the thin beds of clay limestones of the lower Lias rock, which were beautifully shown in the next field to the one in which the shaft was made. It at once then became obvious that, supposing coal to be here in its usual position—namely, below the New Red Sandstones, that we had the whole of the Keuper Marls, the Sandstones, the Magnesian Limestones, the Lower New Red, and the unproductive upper beds of the coal measures, to penetrate—which would amount, I should conceive, at a low estimate, to nearly 1,000 yards; so that, at all events, I could not delay advising the abandonment of the boring, as it would be quite impossible to continue it to a depth sufficient to prove the existence of the coal.

It may now be as well, in completing the sketch of these operations, to inquire whether the practical miner had here any grounds for his conclusions; and it is but justice to him to express a belief that he really thought he had. His reasoning—which was, after all, but a bit of mistaken Geology—was much as follows:—"As we have the red rock on the one side, and the blue rock on the other, between these it would be safe to seek for coal." Now the red rock, the New Red Sandstone, cropped out to the west; and the blue limestones (Lias limestones and shales) formed elevations to the east of the position of the shaft, as may be seen from the accompanying diagram:—

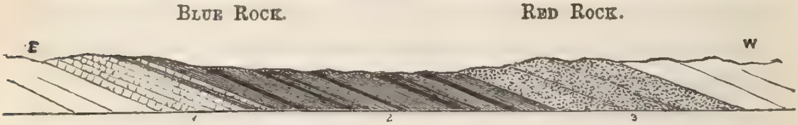
SECTION 2.



1. New Red Sandstone. 2. Keuper Marls. 3. Lias, Limestones, and Shales.

Here, then, the error consisted in the mistaking the Lias for Wenlock Limestone—coal being found in Staffordshire reposing upon the Silurian beds, and lying between this latter deposit and the New Red Sandstone, as in the diagram below.

Section 3.



1. Wenlock Limestones and Shales. 2. Coal. 3. New Red Sandstone.

We see from this instructive case that the mere practical miner was led astray by the glimmering light which he possessed—thus showing how important it is that practice should be guided by a due estimate of the whole of the facts of the case; and the man who is in possession of these will be the *true* scientific man, as he will be the *most* practical one.

(*To be continued.*)

THE COMMON FOSSILS OF THE BRITISH ROCKS.

By S. J. Mackie, Esq., F.G.S., F.S.A., &c., &c.

CHAPTER II.

The Rocks and their Teachings.

(*Continued from page* 103.)

But what are the silent voices of the past saying — for what have the wonderful and mysterious powers of nature for so many ages been labouring? Where, through all the strange mysteries of the past, is the finger of God pointing? To MAN, and the world that is his. Look at all the appropriations of every kind of organic and inorganic matter to such varied and different purposes by our race, and can we divert our minds from contemplating the vast time and the numberless operations which have assisted in the elaboration of the materials necessary for our comforts or our wants? Past and present creations alike show that *animals* fitted for each *peculiar* condition of our planet have existed at every period; but of all those classes which have passed away, or of those which exist, there are none which have not been limited in their geographical range, none to which a considerable other portion of this world has not been useless and unserviceable. Is it so with man? The stars of heaven—how many ages old!—tell him the track of the world he lives upon; mysterious magnetism guides the slender needle by which his freighted ships are safely steered from shore to shore; the very lightning is his messenger. The coal and iron of his mighty engines are ages old; the clay of the bricks of which he builds his houses, and the marble of the statues with which he adorns his palaces, have passed through ages of preparation; innumerable and diversified as are the materials of the earth, has he not a use for them all, from the lowermost granites to the uppermost surface-soils?

Would there have been all these elaborations of the mineral substances, all these ages of manipulation, all these preparatory creations for the hero of seventy years, for the mere *animal* that was to perish with the beasts of the field? No.

> "Life *is* real! life is earnest!
> And the grave is not its goal;
> 'Dust thou art, to dust returnest,'
> Was *not* spoken of the soul."

As on summer's eve, when twilight is fading, the gentle air springs up, tranquillizing the spirit with its cool fragrance; so, o'er the study of the past, come refreshing thoughts of the Eternal.

CHAPTER III.

The Remnants of the First Life-World, and the Bottom Rocks.

Thousands—millions—millions upon millions of years ago! Time, we know, had no beginning, and time, we know, can never cease. Not so creation. Our senses may appal at the thought of the fearful cycles through which the creative energy has been acting; our frames may tremble with emotion in contemplating the vast realms of space through which the Godhead has passed, bringing life out of darkness; but the mind puts a boundary to creation, vast as it is. It looks back to the the time when nothing was, and around, in all directions, to the vast blank beyond the universe of worlds and stellar systems. It feels creation may be going on in the unbounded regions far beyond the limits of our own, and that it may be ever and ever extending; once begun never ceasing, and always exhibiting beneficence and perfection.

The artist has one advantage over the author—the results of his labours burst at once upon the eye; his achievements in all their glory are at once patent and apparent. Line by line must the author work upon the mind of each individual reader; line by line with each individual must he battle with pre-judgment and prejudices; and line by line in each individual and differently constituted mind, must he cause to be developed the same ideas which flow through his own brain if he would achieve success. Line by line, nay, letter by letter, is the history of our planet written; line by line, bit by bit only is the ponderous volume to be read; bit by bit only can the stupendous picture be unrolled, as if the Deity in his mercy spared the intellect of man the maddening glory of the whole dazzling spectacle displayed at once. As, peering into the dark heavens, we perceive the glittering twinkle of tiny stars, and wonder at their distance, so do we look back into the eternity that was, and catch the star-like glimmerings of primeval life upon our globe, and become awe-stricken in the contemplation of the vastness of the ages that have passed away.

Thousands of years ago seems a long time measured by the span of human life; but by thousands of ages is the passage backwards into time reckoned when we speak of the oldest fossils; and yet ages before the period marked by the first traces of organised life, the world, the land was; and the sea, ever rising and falling twice a day in its tidal homage to the moon and sun, was at its ancient toil washing down the mountains, and elaborating the *debris*, sorting the sand, the mud, and the ooze. Schists and slates were being slowly arranged, particle by particle, thousands of feet of stratified rocks were being piled one over the other, and consolidated in solitary silence. Perhaps before the first *worms* made their tracks on the primeval shores—for worm-holes and rain-drops are the first fossils in the rippled sands and sun-cracked mud of that "long, long ago"—other creations lived, whose records have been erased by the fiery touch of the volcano, contact with heat, or the mysterious influences of electricity and metamorphic action; or perhaps, indeed, we have found—but I think not yet—the earliest traces of life and of the seasons.

But let us not anticipate the evidence; and first, then, to proceed, I will exhibit, by a tabulated diagram, the position of what I mean to designate as the "Bottom Rocks," in respect to those other deposits, the organic remains from which are more familiarly known. The table of rock-groups, page 64, and the ideal diagramatic section at page 93, will already have done something towards this, but the more detailed view and remarks I am now about to add will still more explicitly convey a correct idea of our starting point and its relations to these early deposits by which it was succeeded.

OLD RED SANDSTONE.

UPPER SILURIAN.	**LUDLOW ROCKS.** **WENLOCK ROCKS,** (including the Woolhope Limestone and Denbigh Grits and Shales.)	
	UPPER CARADOC. May Hill and Llandovery Beds.	Beds of Passage.
LOWER SILURIAN,	**LOWER CARADOC,** Caer Caradoc and Bala Rocks. **LLANDEILO ROCKS.**	Cambrian of Sedgwick.
	BOTTOM ROCKS	

(Cambrian of Murchison, and of the Geological Survey, but only a part of the Cambrian of Sedgwick), reposing on

GNEISS—FUNDAMENTAL ROCKS—GRANITE.

Between the fundamental gneiss and granite and the lowermost beds of the Silurian formation are mountains of strata, about which, except for their mineral, domestic, or commercial value, little is generally known. Their accumulated thickness is calculated by thousands of feet, and they were formerly styled by geologists Azoic, under the belief that they contained no organic remains, and that they were formed before the dawn of life upon our globe. These are the "Bottom Rocks," which form the subject of this chapter.

(To be continued.)

BRITISH FOSSILS, STRATIGRAPHICALLY ARRANGED.

By John Morris, F.G.S.

I. PALÆOZOIC SYSTEM.

The Palæozoic System comprises the earliest fossil-bearing strata. These have collectively a great thickness, and are of various mineral characters, being argillaceous, arenaceous, and calcareous, generally indurated, and occasionally metamorphosed.

As a general rule, these strata appear in the western and north-western districts of Britain, and, to a considerable extent, in the maritime districts of Ireland. The rocks of this system contain the chief metaliferous workings, as in Cornwall, North Wales, Cumberland, Scotland, &c. The upper portion, namely, the Carboniferous, affords the chief source of our lead-ores which occur in the limestone of Derbyshire, Flintshire, and Cumberland; and the associated shales and sandstones, forming the Coal-Measures, contain the well-known extensive deposits of fossil fuel and iron-ore.

The palæozoic strata are numerous enough and sufficiently distinct among themselves to form several series. The first or lower of these comprises the Cambrian and Silurian; the middle is the Devonian; and the uppermost includes the Carboniferous and Permian.

1. Lower Palæozoic Rocks.

(Cambrian and Silurian.)

The lower portion of the palæozoic system has two great groups of rocks; the lower one is named Cambrian by the Rev. Professor Sedgwick,—from its great extent in Wales;—the other is called Silurian by Sir Roderick Murchison, on account of the typical strata of this group having been worked out by him in the country once inhabited by the Silures,—the border-counties of England and Wales, where the group is extensively developed.

A TABLE SHOWING THE PROBABLE FOREIGN EQUIVALENTS OF THE SILURIAN AND CAMBRIAN ROCKS.

	BRITAIN, *Murchison and Sedgwick.*	FRANCE, *De Verneuil, &c.*	BELGIUM.	SPAIN & PORTUGAL, *De Verneuil, Ribeiro, &c.*	BOHEMIA, *M. Barrande.*	RUSSIA AND THE BALTIC PROVINCES, *Murchison, Pander, &c.*	SCANDINAVIA, &c., *Angelin, Murchison, &c.*	NORTH AMERICA *Hall, Bigsby, Logan, &c., &c.*	AND CANADA, *Rogers.*
UPPER SILURIAN (Murchison) SILURIAN (Sedgwick.)	Tilestones and Downton Sandstones.		The slates and quartzites of the Ardennes may probably represent some Silurian rocks. (See "Siluria.")			Fish-beds and limestone. Oesel and Esthonia	Calcareous flags, Norway		
	Upper Ludlow shales, Aymestry limestone, Lower Ludlow shale. (Kendal group).	……		……	Zone troisième; stages H, G, F, and E; upper and lower limestones and schists.		(Upper Malmo group) Malmo limestone, Graptolite schists, Orthoceratite limestone.	Upper Pentamerus limestone, Delthyris shaly limestone, Lower Pentamerus limestone.	Post-meridian. Meridian. Premeridian.
	Wenlock limestones, Wenlock shale, Woolhope limestone. (Denbighshire grits, and Tarannon shales.) (Ireleth group).	…… ……		…… Light blue shale and argillaceous schists, with *cardiola* and *graptolites*, Serra de Bussaco, Portugal.	……	Limestone with *corals*	Regio E *Cryptonymorum*: limestones with sandstones and shales (Angelin). Coral limestone, Norway.	Water lime rocks, Onondaga salt rocks, Coralline limestone, Niagara shales and limestone.	Scalent.
MIDDLE SILURIAN.							(Lower Malmo group) Upper Encrinal schists Coralline limestone, Pentamerus limestone, Argillaceous schists,	Clinton rocks ………	Surgent.
	Upper Llandovery or May Hill sandstone (Coniston grits). Lower Llandovery sandstone.	……		……	……	*Pentamerus* limestone	D E. *Harparum*. Schists, limestones, with marls (Angelin).	Medina sandstone … Oneida conglomerate	Levant.
LOWER SILURIAN (Murchison) CAMBRIAN (Sedgwick.)	Caradoc sandstone and Bala rocks. (Coniston group)	Ampelitic schists, conglomerates, and ferruginous sandstones of La Sarthe.		Ochreous argillaceous rocks, with *orthis*, &c., near Bussaco, Portugal. Black schists, with *cardiola*, Sierra Morena and South Pyrennes, Spain.	"Zone seconde;" stage D; quartzites.	Limestone with *corals*	(Oscarskal group) Calcareous sandstones Calcareous & argillaceous flagstones. Regio D. *Trinucleorum*: (Angelin).	Hudson River group, Utica slate Trenton limestone	Matinal.
				Quartzites, mica sandstones, carbonaceous schists and limestones, Serra de Bussaco, Portugal. Schists, limestones, and quartzites of the Sierra Morena, Spain.	……	Brandschiefer and Pleta limestone	Graptolitic schist, Orthoceratite limestone (Upper Oslo group). Regio C. *Asaphorum*: B.C. *Ceratopygarum* (Angelin)	Black River limestone Bird's Eye limestone Chazy limestone Calciferous sandstone	Auroral
	Llandeilo rocks	Bluish schists of Angers.							
(CAMBRIAN, Lyell and Phillips)	Lingula flags, Festiniog, Arenig, and Tremadoc slates. (*Stiper stones,*) *Malvern schists ?*	Conglomerates, and sandstones of Brittany.		Schists and sandstones of the Guadarama, Spain	"Zone primordiale;" stage C: protozoic schists.	. . .	Graptolite & Alum schists, (Lower Oslo group). Regiones B.A: *Conocoryphorum* and *Olenorum*. Aluminiferous schists & black limestones. (Angelin).	Potsdam sandstone, 700 ft. thick, Canada. Wisconsin and Minnesota rocks, of D. Owen.	Primal.
	Longmynd and Bangor rocks, Llanberris slates and Harlech grits.	Glossy schists of Brittany.		Unfossiliferous argillaceous schists, with grits, near Bussaco, Portugal.	Stages B and A. Azoic schists.	Shaly & Sandy rocks.	Quartzite & Schists. Regio *Fucoidarum*.	Huronian rocks, of Logan.	
	Gneiss.	Gneiss.		Gneiss & Granite.	Gneiss & Granite.	… ..	Gneiss.	Laurentian (Logan).	

NOTE.—In Thuringia the lower rocks consist of greenish, talcose schists with quartz-veins (Grüne Grauwacke, Richter). These are overlaid by greywacke, sandstones, and slate, with subordinate beds of limestone and aluminiferous schist (Graue Grauwacke, *Richter*). These upper beds contain *Graptolites, Trilobites, Orthoceratite* and worm-like Nereites. See 'Siluria.'

In Norway the Azoic crystalline rocks are succeeded by sandstones, schists, and flags (lower Silurian), limestone with *Pentameri* (middle Silurian), coralline limestone (Wenlock), calcareous flagstones (Ludlow ?).

In Victoria, Mr. Selwyn has shown (Proc. Geol. Soc. March 10, 1858), that the Silurian rocks are well developed, and [illegible] some fossils [illegible] with those occurring in Britain.

Upper Silurian.	Middle Silurian.	Lower Silurian.
(Thickness, 5,000 feet.)	(Thickness, 2,000 feet.)	(Thickness, 19,000 feet.)
Tilestone and Ludlow beds. Wenlock and Woolhope beds.	Upper and lower Llandovery rocks.	Caradoc and Bala. Llandeilo flags. Lingula beds.

Longmynd or Bottom Rocks, or Lower Cambrian of Sedgwick. (Thickness, 26,000 feet.)

A. Lower Cambrian (Sedgwick).

Lower Cambrian, *Sedgwick*, *Lyell* ; Cambrian, Longmynd, or Bottom rocks, *Murchison*, and the Geological Survey ; Cambrian, in part, *Phillips* ; Tremadocian, in part, *Woodward* ; Huronian, *Logan*.

Harlech grits, Bangor & Llanberris slates, Longmynd schists, St. David's schists ; in Wales.	Skiddaw slates and grit-stones, Cumbria. (Lower Cumbrian of Sedgwick.)	Ross-shire conglomerates, Scotland.	Grits and slates of Wicklow and Wexford, Ireland.

The lower Cambrian rocks of Wales consist of grits and conglomerates, at Harlech, and of alternations of gritstones and slates at Bangor and Llanberris; the latter place affording the best roofing-slates. The probable equivalents of these rocks in Anglesea are contorted and crystalline schists, of gneissose, micaceous, and chloritic characters. The Longmynd and Haughmond hills of Shropshire consist of a thick series of dark purple and greenish schists, grits, and sandstones, estimated at 26,000 feet in thickness. These flagstones exhibit trails and holes of worm-like animals, also ripple-marks, and other evidences of littoral or shallow-water conditions. They also yield relics of a trilobite. Similar rocks, but apparently without fossils, occur near St. David's, in South Wales.

To this division Professor Sedgwick refers the Skiddaw slates and grits of Cumberland; these are of great thickness. The purple and green grits and slaty rocks, with occasional interstratified quartz, of Bray Head, Wicklow, and the adjacent coast, in Ireland, belong to this group. In their upper portion have been detected numerous worm-like markings, and the curious fossil known as *Oldhamia*.

The great red conglomerates and sandstone of the north-west of Sutherland and Ross, in Scotland, have lately been proved to be of this lower Cambrian age.

The fossils of these rocks are very few, comprising doubtful remains of fucoids, traces of sea-worms, and a branched zoophytic form, provisionally referred to the Bryozoa.

PLANTÆ. (?).

Chondrites acutangulus, *M'Coy*, Pal. Foss.* t. 1 A. f. 5.

Palæochorda major, *M'Coy*, P. F. t. 1 A. f. 5.

minor, *M'Coy*, P. F. t. 1 A. f. 1.

BRYOZOA. (?).

Oldhamia antiqua, *Forbes*, Sil. 28.

radiata, *Forbes*.

ANNELIDA.

Arenicolites didyma, *Salter*, Geol. Jour. xii. 248.

sparsus, *Salt.*, Geol. Jour. xiii.

Histioderma Hibernicum, *Kinahan*, Dubl. G. J. vij. 184.

TRILOBITIDÆ.

Palæopyge amsayi, *Salter*, Geol. Jour. xii. 249.

Localities: Skiddaw, Longmynd, Wicklow, and Wexford.

B. LOWER SILURIAN (Murchison); MIDDLE AND UPPER CAMBRIAN (Sedgwick.) [UPPER CAMBRIAN AND LOWER SILURIAN, *Lyell* and *Phillips*; TREMADOCIAN, in part, and SNOWDONIAN, *Woodward*.]

NORTH WALES & SALOP.	CUMBERLAND.	SCOTLAND.	IRELAND.
3. Caradoc, Bala, and Hirnant rocks; sandstones, schists, and limestones: Wales & Shropshire. (Upper Cambrian, in part, Sedgwick.)	Coniston grit, with flagstones and limestones. (Upper Cumbrian of Sedgwick.)	Dumfriesshire schists and flagstones.	Flags, slates, and limestones: Wicklow, &c.
2. Llandeilo and Builth flagstones & schists: Wales. (Upper Cambrian, in part, Sedgwick.)	Chloritic schists and porphyry. (Middle Cumbrian, Sedgwick.)	Gneissose flagstones of the North Highlands (?).	Schists: Wicklow (?)
1. Lingula flagstones, Stiperstones, Hollybush sandstone, and Ffestiniog, Tremadoc, and Arenig slates. (Ffestiniog group, or middle Cambrian, of Sedgwick.)		(?)	(?)

These present variable mineral characters, being chiefly clayey and sandy sediments, with occasional calcareous bands, especially in the upper or Bala series. In the lower beds fossils are few; with the increase of the calcareous constituent the organic remains are more abundant.

The period of the formation of these deposits was marked by enormous outbursts of igneous rocks, such as porphyry, syenite, greenstone, and some probably of submarine origin, as the sedimentary felspathic and volcanic ashes of earlier date. There igneous rocks are often interstratified with the beds, and sometimes much altering them. Similar rocks are not wanting in the lower Cambrian series.

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* The abbreviations used in these references will be explained by the list of works that will accompany a future portion of this Catalogue.

The *Graptolites,* which probably represent the modern Hydroid zoophytes, or Bryozoa, according to some observers, are numerous, especially those having a double series of cells. The Graptolites are characteristically Silurian. The *Echinoderms* of this period are chiefly Cystideans. *Annelides* are numerous. None of the higher crustacea occur (neither, indeed, do they until the latest palæozoic times); but *Entomostraca,* especially *Trilobites,* supply the dominant forms of life. The *Brachiopoda* are numerous in species. The other lamellibranchiate molluscs are chiefly the Nuculoid, Aviculoid, and Mytiloid forms. The *Gasteropoda* belong to the holostomatous division. The Cephalopods are chiefly represented by the genus *Orthoceras.*

Characteristic genera.—Plants.—Cruziana, Palæochorda. *Zoophyta,* Didymograpsus, Diplograpsus, Pyritonema, ? Trichoides, Rastrites. *Brachiopoda,* Trematis? *Gasteropoda,* Maclurea. *Pteropoda,* Pterotheca. *Cystidea,* Agelacrinites, Caryocystites, Hemicosmites, Echinosphærites. *Crinoidea,* Glyptocrinus. *Annelida,* Aphrodita, Arenicolites, Myrianites, Nemertites, Nereites. *Crustacea,* Æglina, Amphion, Agnostus, Angelina, Asaphus, Cybele, Cyphoniscus, Eccoptochile, Ogygia, Olenus, Paradoxides, Remopleurides, Staurocephalus, Stygina, Tiresias, Hymenocaris, Cytheropsis. *Bryozoa,* Graptopora.

FOSSILS OF THE LINGULA, LLANDEILO, AND CARADOC BEDS.

PLANTÆ ?

Cruziana semiplicata, *Salter*, Sil. 45
Fucoides gracilis, *Hall*, G. N. Y. 69.
? Chondrites informis, *M'Coy*, P. F. t. 1 A. f. 4.
? ——— regularis, *Harkness*, Geol. Journ. xi. 473.
Palæochorda ? teres, *Harkness*, Geol. Journ. xi. 474.
? Trichoides ambiguus, *Harkn.*, Geol. Journ. xii. 249

AMORPHOZOA.

Acanthospongia Siluriensis, *M'Coy*, Sil. Foss. 67.
Cliona antiqua, *Portlock*, Geol. Rep. 360.

ZOOPHYTA (Anthozoa).

Favosites alveolaris, *Blainville*, Sil, Syst. t. 15 *bis*, f. 2.
Gothlandicus, *Lamarck*, Sil. Syst. 15 *bis* f. 3, 4.
Halysites catenularius, *Linné*, *sp.* S. S. t. 15 *bis*, f. 14.
Heliolites favosus, *M'Coy*, P. F. 15.
inordinatus, *Lonsdale*, S. S. t. 16 *bis*, f. 12.
interstinctus, *Wahl.* S. S. t. 16 f. 2.
megastoma, *M'Coy.* P. F. 16.
petalliformis, *Lonsd.* S. S. t. 16. f. 4.
Heliolites tubulatus, *Lonsd.* S. S. t. 16. f. 3.
Nebulipora favulosa, *Phillips*, M. Geol. ii. 385.
lens, *M'Coy*, P. F. 23.
papillata, *M'Coy.* P. F. 41.
Petraia æquisulcata, *M'Coy*, P. F. 10
Pyritonema fasciculus, *M'Coy*, P. F. 10.
Sarcinula organum, *Linn. Goldfuss*, Petref. 73.
Stenopora fibrosa, *Goldfuss.* sp., Petref. Germ. 82.
Stephodes Craigensis, *M'Coy*, P. F. 30.
Stromatopora striatella, *d'Orb*, Prod. 51.

ZOOPHYTA (Hydroida)?

- Didymograpsus caduceus, *Salter*, G. J. ix. 87.
  - geminus, *His.*, Leth. S. 5.
  - sextans, *Hall*, P. N. Y. t. 74.
  - Murchisonii, *Beck*, S S 695.
- Diplograpsus bullatus, *Salt*, G. J. vii. 174.
  - foliaceus, *Murch.*, G. J. vii. 64
  - folium, *His.*, G. J. vii. 63.
  - mucronatus, *Hall*, P. N. Y. t. 73.
  - nodosus, *Harkn*, G. J. vii. 62
  - pennatus, *Harkn*, G. J. vii. 62.
  - ramosus, *Hall*, *sp.* P. N. Y. t. 73.
  - rectangularis *M'Coy*, P. F. 8.
  - pristis, *His.*, Leth. S. t. 35.
  - teretiusculus, *His. sp.*, Leth. S. t. 38.
- Graptolithus convolutus, *His. sp.* Leth. S. t. 35.
  - Conybeari, *Portl.* G. J. viii. 391.
  - Griestonensis, *Nicol.*, G. J. vi. 63.
  - latus, *M'Coy.*, P. F. 4.
  - lobiferus, *M'Coy.*, P. F. 4.
  - Nicoli, *Harkn.*, G. J. vii. 61.
  - Nilssoni, *Barr.*, G. J. vii. 61.
  - priodon, (*G. Ludensis*) *Bronn. sp.*, Leth. t. 1. f. 13.
  - sagittarius, *Linn.*, G. J. viii. 390.
  - Sedgwickii, *Portl.*, Geo. Rep. 318.
  - tenuis, *Portl.*, Geo. Rep. 319.
- Rastrites peregrinus, *Barr.*, G. J. vii. 59.

(*To be continued.*)

THE SPIRIT OF GOOD BOOKS.

NOTICES OF THE VOLCANIC ROCKS AND GEYSIRS OF ICELAND.

EXTRACTED FROM LORD DUFFERIN'S "LETTERS FROM HIGH LATITUDES."

By the REV. J. E. VAUX, A.M.

OF all the wondrous changes which nature has wrought on the earth's crust, there is scarcely anything that will bear comparison with those which meet the eye of the traveller in volcanic regions. Of the two great agents in Geological transformation—water and fire, the one moves us with admiration at the delicacy of its operations, the other strikes us with awe at the mightiness of its influences, and the rapidity of its work.

Few, if any, countries present us with such remarkable or various manifestations of the potency of subterranean heat as Iceland. So much so, indeed, that it appears as though it were the acknowledged safety-valve, in this portion of our globe at least, through which the troubled contents of depths unknown may, on any emergency, find a ready vent.

Interest more than ordinary appears to have been taken of late in this most remarkable region. No less than six parties of tourists having, during the year before last, investigated the natural marvels of the island. One of these adventurers, Lord Dufferin, in a most interesting and amusing book, has given to the world a record of his travels. From his "Letters from High Latitudes" we propose to quote his graphic picture of the result of volcanic action, in producing a very remarkable and very manifest change in the aspect of the large tract of country to which that portion of his narrative refers.

But before we proceed to this, it may perhaps be useful to recal to the reader's recollection the two theories which have, up to the present time, been put forth with respect to the causes of internal heat, and hence to the origin of volcanic action in general.

Some Geologists are of opinion that the interior of our globe has ever been, and still is, in a state of fusion. The result of experiments, indicating that in mines the temperature increases gradually with their depth, has led to the idea that in the same ratio the temperature must increase the nearer we approach the centre of the earth. Assuming this to be the case, it is calculated that at a depth of fifty miles from the surface the heat would be about double that of molten iron; and the natural difficulty which arises in consequence is this: What would become of the crust of the earth if it confined within it such a mass of fused matter as would be the case if this were true? Other scientific men would rather refer these volcanic disturbances to heat generated by ever-varying chemical changes which are taking place in the bowels of the earth. This theory also is by no means free from difficulties; and it is probable that, in its present state, science is incapable of fully drawing aside the veil, and revealing to our view the true solution of the problem.

We will now, without more ado, introduce our readers to Lord Dufferin, and beg them to imagine his party landed at Reykjavik, a sea-port in the south-west portion of the island, and hurrying forward inland, in an easterly direction, towards the Geysirs. Passing through a variety of scenery, they come out at length to a wide plateau of lava,* stretching away for miles, barren and dismal, innumerable boulders—relics of the glacial period—encumbering their path. At length, at a distance of about five-and-thirty miles from Reykjavik, "I was arrested (says his lordship) in full career by a tremendous precipice, or rather chasm, which suddenly gaped beneath my feet, and completely separated the barren plateau we had been so painfully traversing, from a lovely, gay, sunlit flat, ten miles broad, that lay—sunk at a lower level by a hundred feet—between us and the opposite mountains. I was never so completely taken by surprise. Sigurdr's purposely vague description of our halting-place was accounted for.

"We had reached the famous Almanna Gja. Like a black rampart in the distance, the corresponding chasm of the Hrafna Gja, cut across the lower slope of the distant hills, and between them now slept in beauty and sunshine the broad verdant plain of Thingvalla.

"Ages ago—who shall say how long—some vast commotion shook the foundations of the island, and, bubbling up from sources far away amid inland hills, a fiery deluge must have rushed down between their ridges, until, escaping from the narrow gorges, it found space to spread itself into one broad sheet of molten stone over an entire district of country, reducing its varied surface to one vast blackened level.

"One of two things then occurred—either the vitrified mass contracting as it cooled, the centre area of fifty square miles burst asunder at either side from the adjoining plateau, and, sinking down to its present level, left the two parallel Gjas, or chasms, which form its lateral boundaries, to mark the limits of the disruption; or else, while the pith or marrow of the lava was still in a fluid state, its upper surface became solid, and formed a roof between which the molten stream flowed on to lower levels, leaving a vast cavern, into which the upper crust subsequently plumped down."

His lordship next proceeds to a detailed description of the section, as follows:—

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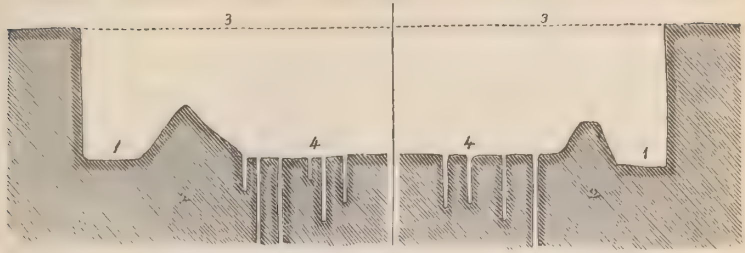
* Trachyte, *i.e.*, lava in which felspar predominates.



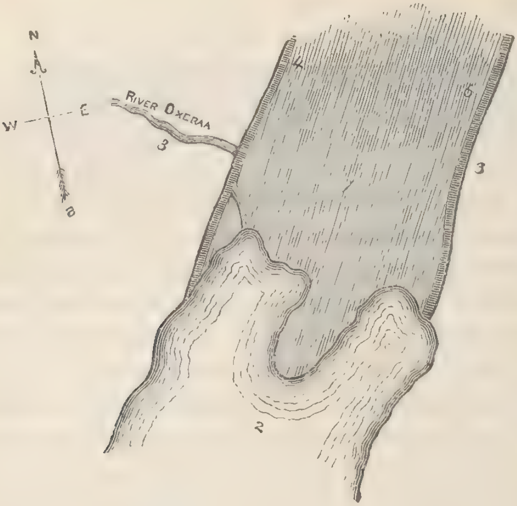
1. Gjas. 2. Lava deluge. 3. Original surface. 4. Thingvalla sunk to a lower level.

"1, 1" are the two chasms, called respectively Almanna Gja, or Main Gja, and Hrafna Gja, or Raven's Gja. In the act of disruption the sinking mass fell in, as it were, upon itself, so that one side of the Gja slopes a good deal back as it ascends; the other side is perfectly perpendicular, and, at the spot I saw it, upwards of a hundred feet high. In the lapse of years, the bottom of the Almanna Gja has become gradually filled up to an even surface, covered with the most beautiful turf, except where a river, leaping from the higher plateau over the precipice, has chosen it for a bed. You must not suppose, however, that the disruption and land-slip of Thingvalla took place quite in the spick and span manner the section might lead you to imagine; in some places the rock has split asunder very unevenly, and the Hrafna Gja is altogether a very untidy rent, the sides having fallen in in many places, and almost filled up the ravine with ruins. On the other hand, in the Almanna Gja, you can easily distinguish on the face marks and formations exactly corresponding, though at a different level, with those on the face opposite, so cleanly were they separated.

"2" is the sea of lava now lying on the top of the original surface. Its depths I had no means of ascertaining.

"3" is the level of the surface first formed when the lava was still hot.

"4" is the plain Thingvalla, eight miles broad; its surface shattered into a network of innumerable crevices and fissures, fifty or sixty feet deep, and each wide enough to have swallowed the whole company of Corah. At the foot of the plain lies a vast lake, into which indeed it may be said to slope, with a gradual inclination from the north, the imprisoned waters having burst up through the lava strata as it subsided beneath them. Gazing down through their emerald depths, you can still follow the pattern traced on the surface of the bottom by cracks and chasms, similar to those into which the dry portion of Thingvalla has been shivered.



1. Plain of Thingvalla. 2. Lake. 3. Lava Plateau. 4. Almanna Gja. 5. Rabna Gja.

(*To be continued.*)

ON SOME NEW PALÆOZOIC CRINOIDS FROM ENGLAND AND SCOTLAND.*

By Professor L. de Koninck, of Liége.

(*From the "Bullet. Acad. Roy. Bruxelles,"* 2 *Ser. tome IV. p.* 93.)

The crinoids, which in this paper I bring under notice, belong to two new genera, which I have designated, the one by the name of *Hydreionocrinus* (ὑδρεῖον, a watering-pot), from the resemblance to the rose of a watering-pot of the head of the species referred to, and the other by the name of *Pisocrinus* (πίσον, a pea). I begin with the exposition of the character of these new genera, and will afterwards describe the species which belong to them, and in doing this I shall make use of the same technical terms as I have done in my other works upon the crinoids.

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* Communicated by the author. The plate accompanying the original Memoir is here used for illustration through the kindness of M. de Koninck.

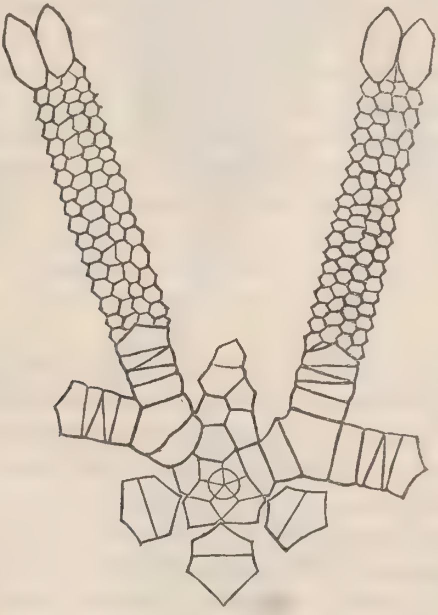
Genus.—Hydreionocrinus, *De Koninck.*

Synonyms.—Poteriocrinus (in part), *Phillips*, 1836, " Geol. of York," Vol. II., p. 204.

Cupressocrinus, *M'Coy*, 1849, Ann. Nat. Hist.," 2 ser., Vol. II., p. 22 4 ; non Goldfuss.

Poteriocrinus, *De Kon.*, 1854, " Recherches sur les Crinoides," p. 90.

Generic Formula.—Basal plates 5, Sub-radial plates 5, of which three are of the same form, the fourth serving as a base to one radial, and the fifth welded to two anals ; Anal-plates 5 ; Radial plates 2 × 5, of which one reposes directly on one of the sub-radials ; Brachial, or arm-plates, 5 × 10, giving rise to 20 arms, welded together, and composed of alternating articulations, to the number of 18 or 20, and surmounted by a circle composed of 15 fusiform pieces, joined to each other. Vault or dome, composed of a great number of little pentagonal or hexagonal pieces. Stem with cylindrical articulations.



In comparing this formula with that of the genus Poteriocrinus, it will be easy to perceive the analogy between them. Indeed, in both genera, one observes five basal plates, which by their junction form a star of five regular rays, or a little cup with the edges cut off and angular. These plates alternate with five sub-radial plates of hexagonal form, but of which two of the lateral sides are sometimes so slightly developed that there appear to be but four, and in this case they affect the form of a lozenge. The two other plates are very much larger; the one, sub-quadrangular, is set directly as the support to the first radial plate, and the other, of an irregular sub-pentagonal shape, supports one of the anal plates, which, to the number of five, are disposed so as to occupy a limited space below, at the base, and on the two sides by the radial plates, which in the two adjacent rays precede the origin of the arms.

The first radial plates are two in number, and are very much alike in the five rays. Each ray bifurcates in its turn, and each of the arms to which it gives rise is composed of five plates, of nearly equal length. The axillary plate is surmounted by two arms, each formed by the union of about two hundred articulations, alternating and attached laterally to each other. The combination of all these arms produces a sort of tube or cylinder, of an elongated form, terminated by a circle of fifteen plates, attached laterally together, serving as the exterior limit of the dome, which is slightly elevated, and composed of a great number of little pentagonal or hexagonal plates, of which neither the form nor disposition is at all regular. I have not been able to observe any trace of a horn or proboscis. The stem is of a cylindrical form, and composed of articulations of a diameter alternately larger and smaller, which make it appear ringed.

Affinities and Differences.—If one had under his eyes only the inferior part of the head or bulb of Hydreionocrinus, it would be impossible to distinguish it from that of Poteriocrinus; the disposition and the number of the different basal, sub-radial, radial, and anal plates being exactly the same in the one as in the other; but, whilst in the Poteriocrinus the arms are generally rather long and entirely free, in Hydreiocrinus they are soldered together in all their parts in the form of a cylindrical tube surmounted by a dome, of which there exists not a trace in the former, and which seems to be wanting in the species of the proposed new genus.

The perfect resemblance of the inferior parts of the bulbs of the two genera now named has been the cause of certain species, of which the

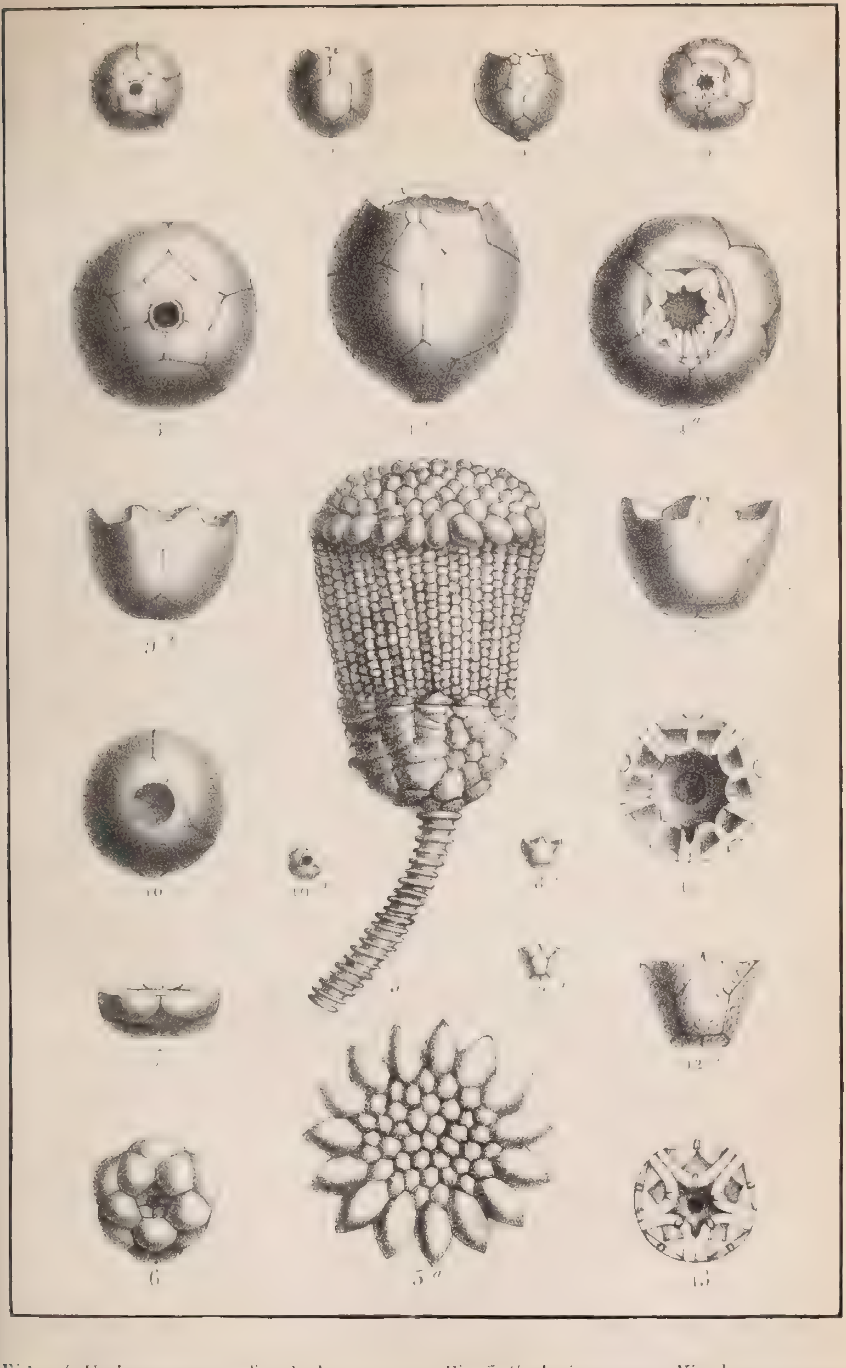


Fig. 1-4. Hydreionocrinus? globularis. de Kon. Fig. 5. Hydreionocrinus Woodianus de Kon.
Fig. 6 et 7. Hydreionocrinus scoticus de Kon. Fig. 8-11 Pisocrinus Pilula. de Kon.
Fig. 12 et 13. Pisocrinus ornatus. de Kon.

calix alone was known, being placed by me and by Mr. Phillips in Poteriocrinus, whereas in reality they belong to another genus, but of which it was impossible then to suspect the existence.

These are Poteriocrinus granulatus, Phil., P. Calyx, M'Coy., P. Phillipsianus, De Kon., and P. Maccoyanus, De Kon. These species are distinguished, nevertheless, from the true Poteriocrini by the brevity and open form of their calix, which is usually conoid in the others. These latter appear to have smooth stems, formed of articulations, having very nearly the same diameter; and, in consequence, not possessing the ringed character above referred to. Two of the species which I have to notice have been placed by Mr. M'Coy (Palæoz. Fossils in Mus. of Cambridge, p. 117), in the genus Cupressocrinus of Goldfuss; and I shall not now dwell on the inexplicable error committed by that palæontologist, because I have already had occasion to refer to it in my "Recherches sur les Crinoides" (p. 88).

It is almost superfluous to add that the genus in question ought to be placed in the family of Poteriocrinidæ.

Distribution.—All the known species of Hydreionocrinus belong exclusively to the "Productus-bed" (P. giganteus.) of the carboniferous limestone. Most of the specimens have been found in England or in Scotland—some in the United States. The limestone of Visé has furnished me with two, but one only is special to it.

(To be continued.)

FOREIGN CORRESPONDENCE.

BY DR. T. L. PHIPSON, OF PARIS.

Mercury in the soil of Montpellier—Mud-volcanos of Java—Ancient superstitions—Fearful eruptions—Origin of the mud in these volcanos—Rarity of Sulphate of Potash in nature—Abundance of Sulphate of Soda—Beds of this salt in Spain.

As early as the year 1760, M. l'Abbé Sauvages made known to the world that mercury, in a metallic state, existed in the soil on which the town of Montpellier is built—a discovery made by himself. Since that time Amoreux, Gouan, Gensanne, and Poitevin have successively mentioned the same fact. Poitevin, in 1830, remarked: "We must not forget a singular circumstance, namely, that the town of Montpellier is built upon a mine of *pure mercury*." He had found this precious metal in many of the streets, in the rue Carbonerie, the rue de l'Université, the Grande rue, the Halle aux Poissons (fish-market), &c. In 1837, M. Marcel de Serres and Leymerie described the ground in which the metal lay, and moreover made known the existence of the latter in the soil of a field which had always been remarkable for its sterility. A few days ago, M. de Rouville and M. Marcel de Serres have again written upon the same subject.

The reason why so many observers should have called attention to this fact is doubtless to be found in the curiosity of such a discovery. In fact, pure quicksilver has, up to the present time, not only been considered a rare mineral, but has almost always been found near the middle strata of the earth's crust, and in those strata which repose upon crystalline rocks. It has, indeed, been mentioned by Mr. Daniel Sharpe as having been met with in the Tertiary sand on which the capital of Portugal is built; and in 1847, some workmen who were laying down gas-pipes at Lyons were surprised at seeing a remarkable quantity of quicksilver filtering, as it were, through the soil in the very centre of the town. The metallic mine indicated by Mr. Sharpe was actually worked for some time; but the presence of mercury at Lyons was attributed to the facility with which this slippery metal, much employed in the manufactories, escapes from the hands of the workmen.

At all events, M. de Rouville has recently discovered, at Montpellier, a new deposit of metallic mercury, which, until now, had never been remarked. In building the foundation of a new fish-market, near the place where the old one stands, a quantity of earth was removed, and a species of pudding-stone, containing the precious metal, laid bare. M. de Rouville describes this pudding-stone as formed of large fragments of limestone strongly cemented together, containing a little silica. It is of a reddish colour, and reposes on grey fresh-water marl, in which M. Paul Gervais formerly discovered the teeth of a new species of monkey. According to M. Marcel de Serres, the following is the description of the soil in which the mercury is found :—

"Uppermost, a bed of reddish mud, then a thin layer of grey marl mixed with gravel and calcareous pebbles about as large as the hand. Next comes a layer of whitish marl, and under this a very greyish calcareous sandstone, containing calcareous pudding-stone and pebbles much smaller than those just mentioned. It is in the fissures of these deposits that the globules of mercury show themselves."

The presence of calomel (proto-chloride of mercury) was also formerly noted by Poitevin, and afterwards by M. Marcel de Serres, in the white marl of which we have just spoken. This substance was seen in small cylindrical branches, but has not been again discovered among the strata laid bare in building the new fish-market.

Mercury generally accompanies cinnabar (red sulphuret of mercury) in nature, but not a vestige of the latter substance has yet been discovered at Montpellier, although a very slight quantity of black sulphuret has been observed; but the presence of this appears to be accidental, *i.e.*, it has been formed since the mecurial deposit has been exposed to the air. As to the pure quicksilver, it is a question whether large fortunes await the good *bourgeois* of Montpellier by the re-discovery of this precious metal in the soil of the town they inhabit. However, if speculation is no better off than before, science has perhaps gained something; for, as M. de Rouville justly remarks, it appears now an established fact that native mercury does not belong exclusively to the palæozoic and ancient secondary strata, but that this metal is also to be met with in some of the most recent deposits which geological science has brought to light.* How it found its way there is a question that will doubtless puzzle geologists for some time to come.

M. Junghuhn, to whose researches we have already alluded in a former paper, and whose name we shall always see with pleasure associated with geological investigation, has passed twelve years of his life in the Island of Java, for the express purpose of watching the volcanic agencies manifested there to so great a degree. The forty-five volcanos of Java, he tells us, are constantly in activity, pouring forth hot acidulated water, ashes, and mud, but no lava. In 1470, when the Mahometans conquered the island, the dominant worship in the country was that of Siva, the divinity of destruction, which proves how closely religious notions may be connected with the natural phenomena or the local physical circumstances of a country. Driven from the plains, the Sivaites retired to the vast craters of their volcanos, and the remains of temples erected by these fugitives may still be seen there. In latter times the last existing worshippers of Siva inhabited the crater of the volcano called Tengger, in the centre of which there is a cone of eruption in full activity. The volcanos of Java lie nearly in a line coinciding with the principal axis of the island, and those of Sumatra form a line parallel to the former. When an eruption occurs, torrents, not of lava, but of mud, roll down the sides of the mountain; when such a torrent meets with an obstacle, the mud generally accumulates on one spot, and there forms a hillock; it is thus that the bases of these volcanos are often seen studded with thousands of these incipient mountains. Sometimes the eruption is dry, or consists only of ashes, as is often the case with the Eamongon and the Semerso. The former volcano detonates once every ten or fifteen minutes, the latter at intervals of about three hours.

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* The mercuriferous deposit at Cividale (Lombardy) and perhaps others, have been referred to the Eocene age. See Jahrb. K.K., Geol. Reichs. Wien, 1855. Galeotti has described tertiary mercuriferous rocks in Mexico.—Ed. Geologist.

The mud which seems to replace lava in the Javanese volcanos derives its origin from the materials of the mountains themselves, whose rocky structures are violently acted upon by the hot acidulated water and the acid vapours emitted from the crater. The latter are extremely abundant at Java, and destroy all kinds of rocks.

In June, 1822, the Gelung-Gung volcano broke forth in violent eruption, amidst earthquakes and subterranean thunder; the inhabitants of the plain were startled out of their *sieste,* at about noon, by a violent report, which was heard from one extremity of the island to the other. An immense column of black smoke was immediately seen rising in the air that completely darkened the sky; volumes of cinders soon fell like a burning rain, the mountain sunk considerably into the earth, and from its fissured sides streamed forth torrents of hot sulphureous water and boiling mud, transforming, in an incredibly short space of time, villages, forests, and rice-fields into a streaming lake, on which trees, fragments of dwellings, and dead-bodies of men or other animals were seen floating along. What a picture of devastation! Another awful eruption of the same kind took place on the 8th and 12th of October. Beudant assures us that in 1772 the highest mountain of Java, the Papandayan volcano, *completely disappeared* *—swallowed up, as it were, in a lake of mud, together with forty villages and their inhabitants.

(*To be continued.*)

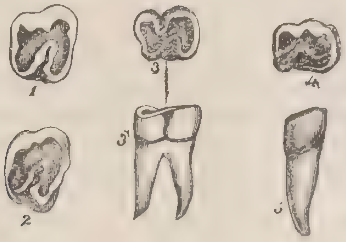
Dr Junghuhn and Mr. G. P. Scrope both consider the truncation of Papandayan to have been due to explosive eruptions, not to engulfment. See Journal Geol. Soc., Vol. XII., p. 331.—Ed. Geologist.

ON SOME TEETH OF THE ANCHITHERIUM, RECENTLY DISCOVERED IN THE ISLE OF WIGHT.

EXTRACT OF A LETTER FROM PROFESSOR PAUL GERVAIS, OF MONTPELLIER, TO DR. T. L. PHIPSON, OF PARIS.

" . . . . I have just communicated to our Academy an observation which may, perhaps, interest the readers of the GEOLOGIST, as it concerns a fossil found in England.

" M. Seamann, of Paris, has sent me five teeth of an animal belonging to the tribe of Pachydermata, and which were found in the Bembridge limestone, at Headon Hill, in the Isle of Wight. This bed also contains remains of Palæotheria, Anoplotheria, &c., that is to say, the animals belonging to the fauna of the *Platières* (Paris tertiary), which, in my work, * I have named the proicene fauna. The accompanying figures will give you an idea of the teeth. Nos. 1 and 2 are molars from the back part of the upper jaw. No. 5 is an incisor tooth. They are all represented of the natural size. The animal to which they belong appears to pertain to the order I have called *Jumentes*, in which we have, also, the horse, the rhinoceros, the palæotherium, and the lophiodon. In my estimation, these teeth belong to a species of *Anchitherium*, and, most probably, to the *Anchitherium Radegondense* (See Gervais Zool. et Pal. pl. xxx.), which I discovered in a bed of lignite at Ste. Radegonde (Vaucluse), in the south of France. This district is, as yet, the only one which has revealed to us with certitude remains of the species in question. Neither the *Platières* of Paris, nor any other contemporary strata, have ever given us the slightest indications of it. It will, therefore, be interesting for you to make known the existence of this fossil in the Isle of Wight."



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* Zoologiæ et Paléontologie Françaises.

LETTER FROM PROFESSOR ANSTED, ON GOLD IN WALES.

To the Editor of the GEOLOGIST.

SIR,—One of your correspondents in the last number of your Journal enquires about the gold of Wales. Perhaps a brief account of the matter will be generally interesting.

There can be little doubt that gold has been obtained in former times by washing the sands of several of the rivers that come down from the slate-rocks in that part of our island,* but it was not until 1843 that the Cwm Hesian Mines near Dolgelly, in Merionethshire, were first noticed by Mr. Arthur Dean, as containing something like a complete system of auriferous veins. An account of this discovery was communicated at the meeting of the British Association at York, in 1844. Since that date the mines have been partially worked, and in 1853 I visited them myself, and carefully examined the district.

The Mowddach Valley, and some of its small tributaries close to the town of Dolgelly, contain the chief mines that have been found to possess any quantity of gold. The metal occurs as usual in a native state, but is found in veins and flucany cross courses, parallel and at right angles to the porphyry range, which here runs north and south through Merionethshire. The nearest fossiliferous rocks are the Lingula-beds of the lower Silurian series, and the veins usually occur in underlying metamorphic schists. The matrix of the veins is quartzy, and the associated minerals either galena and blende, or iron and copper pyrites. In addition to the gold in the veinstone, minute particles are disseminated through the pyrites. I noticed particularly here, and have since observed elsewhere, wherever any gold was present in veins, that more or less magnesian mineral (generally chlorite or steatite) is found in the immediate vicinity. At the time of my visit one of the strings of gold-bearing quartz in chloritic schist was opened, and I obtained from a few specimens of quartz, struck off whilst I was underground, very distinct threads and grains of gold; the general yield of the small quantity thus removed being at the rate of 60 ounces of gold to the ton of matrix. Further researches, however, failed to discover any quantity worth working, and the mine has, I believe, been since neglected. At Clogau, not very far off, other auriferous specimens far richer were obtained a year or two after my visit, but here, also, the works are stopped.

Generally it may be said that the gold districts of Wales are limited to those places where the rocks are not only schistose but chloritic or steatitic. They present a very marked resemblance to those of other countries where gold occurs more abundantly, but much more especially to those of the South-Eastern States of North America, where almost all the indications of the associated rocks and the minerals are precisely similar. No doubt in former times, when nearly all the rivers of Western Europe brought down appreciable quantities of gold, or at least when the accumulations of ages were still untouched, the Welsh streams, as well as the German, French, and Spanish rivers, were rich in golden sands. These have long since been removed, whilst at the present price of labour, and with the extreme irregularity of distribution that seems always to obtain where native metals exist, it is almost a hopeless chance to expect profit from mining or reducing establishments on a large scale.

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* The Romans obtained gold from quartzy lumps in slaty rocks at South Gogofau, about 10 miles west of Llandovery. They also appear to have ground down the iron pyrites of the same district, which they afterwards washed for gold.

I am, &c.,

D. T. ANSTED.

17 Manchester-street, 17th March, 1858.

NOTES AND QUERIES.

Determination of Fossils.—Inquirer (Harwich).—"In my district I find abundance of certain fossils, but not having any large library accessible to me, nor any learned friend to whom I could appeal, and as I cannot afford to expend much money in books—indeed, even those I possess, through my inexperience, do not afford me that certainty of determination which, as a foundation to further efforts, I so much desire—can you inform me of any ready and inexpensive means of learning their names?"—Similar difficulties in naming fossils have been made known to us, as experienced by W. H. Y. (Sherborne); T. H. (Hinckley); A. C. C. (Forfar); Student (Blyth); J. P. (Stowmarket); W. E. (Chudleigh); R. F. (Tonbridge); W. E. (Chester); Rambler (Swindon); H. P. (Ledbury); I. C. C. (Saffron Walden); A Collector (Felixstow). We have received such very numerous inquiries of this nature, as to make us regard this difficulty, experienced by isolated students and beginners, with much interest. If duplicate specimens are sent free to the Editor, with numbered lists and localities, addressed to the care of Mr. Allen, 2 Catherine Street, Strand, such lists will be returned as soon as convenient, with the generic and specific names inserted.

Provincial Correspondents.—A correspondent at Worcester writes, that he thinks "local facts should be especially looked to, and every effort made to obtain the latest observations, such as might be long in getting into the Proceedings of the Geological Society, &c.; and to ensure this it is perhaps not enough that a number of names appear as contributors, but that in each county or district some one or two correspondents should regularly be engaged to forward to the Editor all new facts and observations connected with their districts."—We print this extract from our correspondent's letter, because it accords with our own views and wishes, and with those which other correspondents have communicated to us. We have already commenced taking steps to obtain such a combination of workers, which, more than anything else, will tend to keep up the standard of the Geologist as a work of merit, and to maintain its name in popular favour. If the working geologists and amateurs in the country will forward to us accounts of their discoveries, we will do our best at all times, in this great city, where the best can be done, to render their labours available for the progress of science. We should be pleased to have regular correspondents in every district; but these, of course, must be voluntary helpers, as our resources would not permit such a staff of paid contributors. The correspondent at Worcester from whom we have quoted, recommends the report, *in full*, of the proceedings and excursions of *all* Field Clubs. There is very often more conviviality than science in these meetings, and we only consider it necessary to report that which has a scientific value. We should be obliged to the secretaries of Field Clubs or Naturalists' Associations for notices of the proceedings, as we by no means under-rate the utility and practical value of such institutions. We have no intention nor wish to anticipate the published records of the Geological Society. Very little, we think, of importance escapes a ready notice from some of its learned members, and few journals contain such a mass of new and valuable matter as the "Quarterly Journal" of that body. Our business is more to distribute and make popular that which *is* known. Our articles ought to be safe and practical—something to be depended upon by students and provincial geologists; and it is not speed for novelties that should be the first consideration, although, for the sake of our scientific readers and supporters, we shall not neglect any available source of obtaining the earliest information on various subjects, and of making it known. By means of the combination of local workers which we have suggested, we trust to render good service to all learned societies, by bringing together rapidly many coincident facts, which may have a natural bearing upon the subjects of those papers which practical geologists are preparing to produce in a more scientific form than would be ordinarily adapted for our pages.

Fossil Remains.—Extract of a letter from the Rev. W. S. Symonds, of Pendock.—"Near Waterford a quarry has been discovered, with numbers of specimens of the peculiar 'Yellow Sandstone' fern, known as Cyclopteris or Sphenopteris Hibernica, in full fructification."

Books.—Geologist asks to be informed the prices and publishers' names of certain works.—"The Proceedings of the Geological Society" have been published by the Society itself, at the apartments at Somerset House. They date from 1826 to 1845. Vol. i., price 4s. 6d.; vols. ii. and iii., 2s. 6d. each. Vol. iv. is imperfect.—"The Transactions of the Geological Society:" all the first series is out of print, as well as Vol. ii of the second series. The remainder of stock was bought some time ago of the Society by Mr. Lumley, bookseller, Holborn, excepting the last part of Vol. vii.—"The Quarterly Journal of the Geological Society" is published by Messrs. Longman, as well as by the Geological Society. The price of each number is 3s. to Fellows, and 4s. to the public. Vol. i. is imperfect. Volume xiv. is now in progress. The price per volume (in cloth) is 13s. 6d. to Fellows, and 17s 6d. to the public.—The "Memoirs of the Geological Survey" are numerous. The principal are the "Report on Cornwall, Devon, and West Somerset," by the late Sir H. T. De la Beche, F.R.S., 8vo, 14s.; "Figures and Descriptions of Palæozoic Fossils" in those counties, by Professor Phillips, 8vo., 9s. Two volumes of "Memoirs of Geological Survey of Great Britain, 8vo., vol. i., 21s.; vol. ii., in 2 parts, 42s. Several "Decades of British Organic Remains," each, royal 4to., 4s. 6d., or royal 8vo., 2s. 6d. Lists of the publications, books, maps, and sections, of the Survey may, we believe, be obtained through any bookseller; of Messrs. Longman; or at the Museum of Economic Geology, in Jermyn-street, Piccadilly.

"Will you kindly inform me when it is probable the second volume of Mantell's 'Wonders of Geology,' by Mr. Rupert T. Jones, will be published?"—J. C., Hereford.—The second volume was published on the 12th ult.

Parallel Road in Sutherland.—Sir,—In answer to your appeal in your opening address, for assistance in the way of contributions, allow me to offer my mite as an evidence of my wish for the success of your Magazine. "The parallel roads of Glen Roy" having been long known and frequently described, I would direct the attention of those who feel an interest in such matters to a similar appearance, which, so far as I know, has not yet been visited or examined by any geologist. I had occasion, about six years ago, to visit the spot, and I walked along this road for about the space of a mile. It is situated in the county of Sutherland, about half-way between the Inns of Tongue and Betty Hill, on the Thurso road, and is on the farm of Borgie. The road may be found opposite the farmhouse, on the other side of the river of Borgie. It is evidently the margin of what was once a lake, and which must have communicated with Loch Loyal. The site of the pleasantly-situated farmhouse must have been at one time covered with water, and what is now under cultivation was once the bottom of a fresh-water lake. The lower end of this valley must have given way, and allowed the waters of the lake to run into the sea. Very near this spot, a singular platform of sand and detritus may be seen; so extensive is it, that a volunteer regiment used to exercise upon it. It would seem to be the residuum left after the bursting out of the waters, but there is no appearance of a "road" on the western side of the valley, from which I came to this conclusion—that, during the time of the existence of the lake, the prevailing winds must have been what they are at this day in that county, viz., W. and S.W.; because these winds alone could have caused those waves which have left their traces on the east side. As I do not wish to trespass at length on your columns, I will only add that a visit to this locality will afford much interest to the geologist. I have sent these remarks, hoping it may be the means of inducing some one, possessed of more time and a fuller acquaintance with geology than myself, to work out more effectively the problem offered in this interesting locality.—*Extract of Letter from Rev. Eric Findlater, of Loch Earn Head, by Crieff.*

NOTICE OF A STALACTITE CAVE AT CHEDDER CLIFFS, BY MR. J. JAMIESON.—"The following description of a Stalactite Cave at Chedder Cliffs, Somerset, will, I think, be found interesting: and as similar contributions describing the localities where remarkable phenomena may be seen and admired will, in some measure, enhance the value of your Geological Magazine, it will afford me pleasure if you should think this worthy of insertion.

"Yours obediently,

"J. J.

"Arlington Square, London, 5th March, 1858."

The cliffs and rocks most picturesquely arranged on each side of the Banwell-road, about three miles from Chedder, will alone amply compensate for the time and trouble of the journey to view them; but this locality possesses an additional attraction, in a most wonderful Stalactite Cave, discovered accidentally by Mr. George Cox, on his own property, in the valley leading to the cliffs, where he was excavating the limestone to form a stable. It has since been made perfectly easy of access. The beauty of the cave and its formation—the work of ages and of centuries hardly to be numbered—make it one of the most wonderful objects which can be contemplated. The strange variety of the incrustations, with the enchanting reflections of the scenery in the beautiful natural basins of pure water; the pillars, the festoons, pendant from the roofs of the different alcoves, bring the fancies of enchantment into real existence. The water still continues dropping from many capillary openings in the roof, and, in addition to its forming stalactitic curtains and festoons from the dome of the cave, gives rise also to equally beautiful concretions of stalagmite on the floor beneath, whence pillars of a substance as semi-transparent and as white as statuary marble, formed by calcareous deposits from the continuous droppings from above, are seen gradually rising to meet the elegant pendants from the roof.

The following letter of the late Rev. W. D. Conybeare, cannot fail to be perused with much interest, in connection with this notice:—

"Stalactite Cavern, Chedder, 1st July, 1843.

"DEAR BUCKLAND,—Happening to be visiting a friend, with my youngest boy, I chose to go round from Banwell hither, to show him Chedder Cliffs, and visited this cavern, more to show it to him than expecting to see anything myself; but I think it ought to be better known. You must come and see it yourself; it is really the only graceful cave fit for ladies to visit which we have; the only thing I ever saw that at all realizes my ideas of Antiparos. It has one main porch and three or four lateral branches, narrow fissures, about ten or twelve feet broad, and some thirty or forty feet high, vested and draped with the most fantastic and beautiful marble stalactite one can conceive. The floor, when discovered, was a mass of stalagmite, covering rounded gravel of the mountain limestone, filling up about ten feet of the bottom. The owner has cut galleries through this stalagmite, and he is one of the best showmen of a cave I ever saw, lighting the whole with a group of candles on a tin plate, which he raises to the roof, or thrusts through the narrow fissures, so as to exhibit the whole to perfection. Make this known as the prettiest thing in the island, and come and see it.

"W. D. CONYBEARE."

Mr. Cox has laudably determined that the contents of the cave shall not be broken up nor disturbed, anticipating the probability of its being honoured with a royal visit.

Polar Forces and Cleavage: Centres of Creation.—X. Y. Z. (Dublin).—"Sir,—If it would not be trespassing too much on your kindness, would you favour me with answers to the following, through the medium of your monthly paper The Geologist ?—It has always seemed to me that geologists, in speaking of *polar forces*, in reference to cleavage, only *shift* the difficulty by giving it a name, as I have never been able to understand what they mean when *they* use this term, or how such forces could act effectually. Can you inform me under what plea any geologist objects to there being only one centre of creation, and requires more ? I cannot imagine, and have never been able to find anywhere stated, what the necessity may be which renders it necessary to suppose more than one. Lastly, perhaps you can suggest to me some elementary and, at the same time, extensive and sound work on the previous of these two questions, viz., cleavage."—The hypothetical application of polarity as an agent in the cause of cleavage is not admitted now by most geologists, *lateral pressure* being the fashionable doctrine. The well-known polar forces of electricity and magnetism have been used hypothetically and by way of analogy by some authors, in explanation of the changes which some of the old rock-masses have undergone, and in reference to the formation of certain mineral veins. This subject has been well treated by Mr. Robert Hunt, in the "Memoirs of the Geological Survey," and by Mr. R. W. Fox, in the "Philosophical Transactions," and there is a *résumé* of the subject by the late Sir Henry de la Beche, in his "Geological Observer." Mr. Evan Hopkins has given a very wide range to the probable action of these so-called "polar forces." St. Helena, Galapagos Islands, Van Diemen's Land, Australia, and many other instances might be adduced of the existence of local faunas and floras, which it would be very difficult to understand if we were to suppose there had been only one centre of creation. This subject is well treated in Sir Charles Lyell's "Principles of Geology," and, with respect to the floras especially, has been well illustrated by the late Professor Edw. Forbes, in the "Memoirs of the Geological Survey." Our correspondent's last question facetiously reminds us of the old woman with bad eyes, who went to the Boston bookseller for a new Bible of the largest print, smallest size, and cheapest price. The question is, however, a very proper one, and we reply to all such with much pleasure. Unfortunately there is no such collective work as X. Y. Z. requires on the subject of slaty cleavage. Mr. H. C. Sorby and the late Mr. Daniel Sharpe have written some admirable essays, and have done much in elucidation of this matter, and there is the first part of a report by Professor J. Phillips, in the "Report of the British Association for 1857," in which a general review of what has been done is commenced, and in which the chief labours hitherto made in this direction will be found embodied. The last edition of Lyell's "Manual" contains a *résumé* of some of the later researches on this point, and Mr. Jukes, in his "Manual of Geology," lately published, ably treats of it in his chapter on Physical Geology.

Elementary Works.—J. H. M. (Staines) asks what is the best elementary geological work for a young man to study ?—Sir Charles Lyell's "Elements of Geology," and "The Principles of Geology," by the same author, "The Wonders of Geology" and "The Medals of Creation," by Dr. Mantell, are first-rate books. The last edition of the "Wonders" being printed under the revision of T. Rupert Jones, Esq., the assistant-secretary of the Geological Society, the newest discoveries and latest determination of the science are in it engrafted on the original labours of that late eminent geologist. Sir Charles Lyell, we all know, brings every new edition of his two celebrated works completely up to the mark. Other excellent works which occur to us are Page's "Text-book of Geology;" Professor Ansted's "Geology;" Professor Phillip's and Professor Jukes's Manuals, and the late Sir Henry De la Beche's "Geological Observer." Miss Zornlin has written, too, some very pretty rudimentary books.

Allophane.— Z. (page 116.)—Allophane occurs at New Charlton, near Woolwich, Kent, in chalk, and is of a white honey yellow, or red colour. That from Beauvais, in France, analysed by Berthier, is also of a honey yellow colour, and found in chalk. It occurs lining small cavities, and in veins, sometimes in little reniform masses, and with a resinous or waxy lustre; the analysis is as follows:

	$\dddot{S}$	$\dddot{Al}$	$\dot{H}$	$\dot{Fe}$	$\dot{Ca}$	$\ddot{C}$
Woolwich.—	20.50	31.34	42.91	0.31	1.92	2.73=99.71.—A. B. Northcote.
France.—	21.90	29.20	44.20	Clay	4.7 = 100.—Berthier.	

J. R. G.

To the Editor of the GEOLOGIST.

SIR,—I beg to inform your correspondent, G. S., that it is in the Dolgelly district of North Wales where auriferous minerals have been chiefly discovered, and where the geological conditions are said to be analogous to those of some other gold-producing countries. Gold has been found in the mines known as Vigra, Clogau, Caegwain, Wellington, Victoria, Lachfraith, Cambrian, Prince of Wales, West Prince of Wales, Glasdir, Tyddyngwladis, Dolfrwynog, North Dolfrwynog, West Dolfrwynog, Cwmheisian, Berthllwyd, and Caegwernog. I have myself found gold in quartz, carbonate of lime, slate, chlorite schist, blende, galena, copper pyrites, iron pyrites, tetradymite, and bismuthine; and of its occasional occurrence in extraordinary richness in the Clogau, Cambrian, and Dolfrwynog mines I possess remarkable proofs. To my own knowledge, so recently as 1856, as much as 14½ ounces of gold were obtained from 100lbs weight of quartz, taken from the Clogau mine, and many samples of 14lbs. weight from the Clogau and Cambrian mines have yielded in the proportion of 1 to 10 ounces of gold to the ton of quartz. Hitherto the attempts to extract the gold on a commercial scale have not proved successful. This does not obliterate the mineralogical facts. Whether gold exists in remunerative quantities in the rocks of this district, although it may not be actually visible, remains still undetermined. Perhaps it does not; but this point, however, is *not proven*.

Yours, &c.,

T. A READWIN.

4 St. George's Square, Pimlico, 20th March.

GOLD IN WALES.—G. S. (page 116.)—The gold in North Wales is found chiefly in Merionethshire, at several places near Dolgelly, principally at Cwm-y-swm, Clogau, and Dolfrwynog; it occurs in a granular and cellular quartz, with much mica in fine scales, and stained brown by peroxide of iron, at Cwm-y-swm and Clogau, with galena, blende, and copper-pyrites, very finely disseminated. The whole district consists of a quartz and mica-slate rock, with sometimes thin layers of clay-slate, and the quartz in veins, from a quarter of an inch to several feet in thickness, and generally much decomposed and ferruginous, and no doubt often auriferous. I received three or four ounces from Dolfrwynog a few years ago, as a specimen, it was washed from the pulverized rock; it is always of a pale yellow colour, and the particles are more or less mixed with quartz. The specimens I had were worth about £3 8s. per ounce.—J. R. G.

We were aware of the paper read on November 19th, 1856, by Professor J. Morris, before the Geological Society of London, and published in the Thirteenth Volume (1857) of the Quarterly Journal of that Society, as well as of Mr. Northcote's article on the composition of Allophane, in the Thirteenth Volume of the Philosophical Magazine. We were also aware of several papers on the second point—that of gold in Wales. But we left both questions open, in the expectation that some of those scientific geologists whom we know possess information respectively on these subjects would kindly add something new to the general stock of knowledge.

We would further take this opportunity, while thanking Professor Ansted, Mr. Readwin, and J. R. G. for their notices, to add, that, although in most cases, unless for some such special reason as that we have mentioned, we answer the queries in the same number in which we print them, we do so only to give early information to those who require it, and we shall always be obliged to our readers and correspondents for any additional matter.

EARLIEST RAIN-DROPS.—E. R. J. (Farnborough).—"I shall be much obliged if you will inform me, through the medium of your Geological Journal, which is the *earliest* strata that shows marks of rain-drops? I have seen it stated that they are found as early as the Old Red Sandstone; which, if it be so, seems to raise a difficulty in connection with Genesis ii., 5, where it is written that no rain had fallen up to the carboniferous period. I should also be glad to know whether there is anything like a descriptive catalogue of the Geological contents of the British Museum to be had."—Rain-drops have been found in the *lowest* of all fossiliferous rocks, the "Longmynd, or Bottom rocks" of Shropshire, by Mr. Salter. Wherever sedimentary deposits have been going on, there has been evaporation of the surface-water, and atmospheric condensation or rain. One condition necessitates another, and co-existent at least with the evidences of life must be the records of atmospheric phenomena. There is no official descriptive catalogue of the fossils in the British Museum. The late Dr. Mantell's "Petrifactions and their Teachings," published by Bohn, was designed as a hand-book to the gallery of organic remains, and will be found of great use to the student both there and at home.

EXCHANGE OF FOSSILS. — Extract of a letter from E. Wood, Esq., F. G. S. Richmond, Yorkshire.—"Will it be in accordance with the rules of your admirably conducted journal, to state publicly what I should require a secretary to do privately, that the new Crinoids, figured and described in your first number, have all been discovered, and every specimen disseminated by myself? The only quarry in which they are found is being worked purposely, and much labour expended in the excavations. About six perfectly distinct species of the first-named genus have been examined and named by my learned friend, Professor de Koninck, and recently another new and very beautiful genus has been added to the list, on which the Professor has just read a paper in Paris, calling it *Hydreionocrinus*; this species I hope to enable you to figure very soon. What I wish your readers—and their name must be legion—to know is, that being engaged in the formation of a good private collection of British fossils, I shall be always glad to distribute my duplicate specimens, in the way of "friendly exchange," and that the senders of *good* specimens from British localities will be sure to receive a liberal return of, at all events, the type species."

NOTE.—The Editor will be happy at all times to promote the interchange of specimens, and to afford any assistance and facilities which his capacity enables him to do in the formation of public or private collections. For the description of the genus Woodocrinus referred to, see the article by Professor de Koninck, and Mr. Ed. Wood, page 12.

E. A. W. (Sidcot, near Weston-super-Mare).—"RESPECTED FRIEND,—Having discovered about a year ago, at Chedder Cliffs, a fossil called Beechite, I should feel thankful if thou wouldst give me any information respecting it—to what class of animals does it belong? what are its habits? and where is it generally found? The above mentioned was taken from the mountain limestone. In reading the GEOLOGIST, No. II, I met with the term 'Geodes'; may I trouble thee to explain it? How are the Naturalists' Field Clubs conducted?"—Beekites are rolled fossils of the Devonian rocks, embedded in New Red Conglomerate, afterwards coated with chalcedony, and subsequently the original fossil has decayed, leaving a cavity. A notice of them will be found in the "Report of the British Association, for 1856," sect. p. 74. Our correspondent's fossil is not, we fancy, a true Beekite; but, as we have neither description nor drawing to guide us, we cannot, of course, make any decision. There are somewhat similar bodies called "potato-stones," found in the mountain limestone and red sandstone of the Mendip Hills. These are more or less globular, hollow, siliceous bodies, their inner surfaces often exhibiting beautiful crystals of silex (quartz), lime, barytes, &c. Geodes are merely nodular concretions of earthy matter, whether ferruginous, argillaceous, calcareous, or siliceous. On the third point we request information from the secretaries and members of such institutions.

W. S. (Bristol).—"Sir,—Can you give me any information in the next number of the Geologist as to the fossil remains called Palates—are they the teeth, or are they any other parts of mammals, fishes, or reptiles? I have consulted various books, but in none of them can I find any reference to them. I have collected up to the present time, in this neighbourhood, about twenty different kinds, and should much like to know in what work I could find out their designations."—The "Palates" alluded to by W. S. are the dental plates—crushing teeth, in fact—arming the jaws of certain species of sharks and rays. The fish of the cretaceous sea, whose palates are so well known in the chalk, have their nearest living representative in the Cestracion of Port Jackson (Australia). The palates from Bracklesham Bay have their representatives in the Eagle-rays of our present seas. We shall shortly print, in our gems of private collections, a more ample notice of these remains. Agassiz's great work, the "Poissons Fossiles," is the great authority for fish remains; but its price necessarily renders it a scarce work. W. S. will find notices of these fish palates in Mantell's "Wonders," and Lyell's "Manual of Geology."

H. W. (Bury St. Edmunds).—"I should be much obliged if you or any of your correspondents could inform me of the probable cause of the occurrence of thick veins of sand that are found penetrating, or rather filling up deep cylindrical holes in, the chalk, often to the depth of thirty feet or more; they are called by the quarrymen 'sand golfs, or gulfs.' We are in this neighbourhood upon the upper chalk formation, with regular layers of flints (horizontal), and the chalk of a moderate hardness."—When the chalk and the Tertiary deposits lay level previous to the upheaval of the Wealden dome, the drainage water of the Tertiaries could only pass off by filtering down perpendicularly through the chalk. The water thus filtering downwards is considered to have been impregnated with acidulous gas, and by this means to have acted with energy on calciferous rocks in dissolving out these pipe-like cavities, into which, as by this action they were constantly being deepened, the superincumbent tertiary sands and clay gradually sank. But after the lifting up of the Wealden area the surface waters went off by the slopes of the higher ground into the lateral valleys. In Dorsetshire and Wiltshire these beds are still horizontal, and in the large districts of Bagshot Sand, yet remaining *in situ*, many "swallow-holes" or cavities occur, in which streams or water-courses suddenly disappear. Such is the commonly received notion of the sand-gulfs H. W. alludes to, which are more generally known as sand-pipes. Mr. Prestwich follows Sir Charles Lyell and others in considering these pipes to be the effects of water, charged with carbonic acid gas; and there are some excellent papers on the subject by that gentleman in the Tenth Volume of the "Geological Journal," p. 222 and p. 241, and in the Eleventh Volume, p. 64. The late Mr. Trimmer considered these sand-pipes as due to the waves of the sea, in producing a vorticose action of pebbles and sand at the termination of long furrows in the surface of the chalk, by which these long cylindrical or conical cavities were "wormed" out, as it were, by a kind of natural auger or drilling machine. Mr. Trimmer's papers will be found in Vol. X. of the "Geological Journal," p. 231, and p. 274.

R. G. E. justly complains that having written in reply to an advertisement in our second number, offering an exchange of fossils, he has had his letter returned through the Dead Letter Office. R. G. E. also offers to exchange crag fossils for any specimens from beds below the greensand; but as the initials are the only signature to the note we have received, and London the only address, we cannot do more than acknowledge our correspondent's letter, as our readers would be in a similar dilemma to himself in any attempt at correspondence or exchange. We have learned from the late proprietor the name of the advertiser, and can but think the return of our correspondent's letter a mere accident.

A Young Inquirer.—"Sir,—Can you give me an explanation of the extraordinary abundance of oxide of iron in the Red Crag of Suffolk, as shown by the deep colour of the fossils, and their matrix? I have been rather puzzled by a curious fossil from

Walton, given in the stratigraphical charts as the ear-bone of Balæna emarginata. What is known of this animal? and from what part of the body does this bone come? I imagine it is named from its shape, which is like that of an elongated human ear. I fear my questions must seem very trivial to experienced geologists, but they may have occurred to other beginners, who, like myself, would be glad to have them answered."—It is not easy always to state the source of iron in rocks. One might generally attribute the presence of that metal to the disintegration and waste of the previously existing rock-masses. The crag most probably derived its ferruginous character from the oxides of iron which extensively permeate the London clays, and from the dark brown beds at the base of the London tertiaries, which are as rich in iron as many valuable ores. The fossil to which a Young Inquirer refers is really a cetotolite, or ear-bone (os petrosum) of a kind of whale. Otolites is a term applied to the little loose internal bones in the ears of fishes; these, from their hard structure, often resist decay. The hard bone coincident with the ear-bone in mammals, the os petrosum, being of a harder substance than the rest, is also often preserved in the fossil state.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—February 19, 1858, Annual General Meeting. Major-Gen. Portlock, President, in the chair. After the usual reports were read and adopted,

The President announced the award of a Wollaston medal to Herr Hermann von Meyer, of Frankfort-on-Maine; and in doing so, alluded to Von Meyer's successful Palæontological labours during the last twenty-five years. Sir C. Lyell having been requested by the President to transmit the medal to Herr v. Meyer, stated that it would give him great pleasure to take charge of the medal which had been awarded to his distinguished friend; to some of whose works he then particularly alluded, especially the great monographs on the Carboniferous, Permian, and Triassic Reptiles.

The President then announced the award of another Wollaston medal, and the balance of the proceeds of the Wollaston Fund to Mr. James Hall, For. Mem. G.S., the State Geologist of New York, and requested Sir Roderick Murchison to transmit it to the Medallist, of whose long-continued and successful labours among the Palæozoic rocks and fossils, and of whose important services to Geological Science, Sir Roderick then spoke warmly, expressing the gratification he felt in the adjudication of the highest honour the Society can bestow to so eminent an American geologist.

The President proceeded to read his Anniversary Address, and commenced with biographical notices of some of the lately deceased fellows and foreign members of the Society, particularly the Very Rev. Dean Conybeare, the Earl of Ellesmere, Mr. H. J. Brooke, Mr. Joshua Trimmer, Mr. W. Bald, M. Dumont, M. Dufrénoy, M. A. d'Orbigny, and others.

The ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—President, Prof. John Phillips, M.A., LL.D., F.R.S. Vice-Presidents, John J. Bigsby, M.D.; Hugh Falconer, M.D., F.R.S.; Leonard Horner, Esq., F.R.S.L. and E.; Sir R. I. Murchison, G.C. St. S., F.R.S. and L.S. Secretaries, Thomas Davidson, Esq., F.R.S.; Warrington W. Smyth, Esq., M.A. Foreign Secretary, William John Hamilton, Esq., F.R.S. Treasurer, Joseph Prestwich, Esq., F.R.S.

February 24, Ordinary General Meeting.—Prof. Phillips, President, in the chair. The following communications were read:—

1. "On the gradual elevation of a part of the Coast of Sicily, from the mouth of the Simeto to the Onobola." By Signor Gaetano Georgio Gemmellaro. Communicated by Sir C. Lyell, F.G.S.

In this paper the author described in detail the physical evidences observed by him along a great part of the eastern coast of Sicily, which prove—1st, that from the shores of the Simeto to the Onobola undeniable characters of the former levels of the sea in the recent period are traceable from place to place. 2ndly. That great blocks of lava, with blunted angles, and rolled and corroded on the surface, a calcareo-siliceous shelly deposit, and a marine breccia, which are seen at different heights, above the present sea-level, are the effects of the continued and daily action of the waves of the sea at successive levels. 3rdly. That the existence and disposition of the holes of *Modiola lithophaga*, Lamarck, in the calcareo-siliceous shelly deposit, and the local presence of shells, both gasteropods and lamellibranchiates, in their normal positions, support the view of a slow and gradual elevation of the coast. 4thly, and lastly, that the lithodomous molluscs and the calc-siliceous deposit being found on the Cyclopean Islands (Faraglioni) up to the height of almost 13 metres, and large rolled blocks of lava, invested with *Serpulæ* being also found there to the height of 14 metres, a mean height of 13 metres and 5 decim. is established as the greatest extent of the now undeniable gradual elevation of this portion of the coast of Sicily during the present period.

2. "On the occurrence of Fossil Shells and transported Pebbles and Boulders at high levels in Aberdeenshire." By T. F. Jamieson, Esq. In letters to Sir R. I. Murchison, V.P.G.S.

The author stated that he had found indications of the district having been submerged beneath the sea to the height of about 430 or 450 feet for a considerable time during the later Tertiary period. Extensive ridges or hillocks of water-worn gravelly *débris*, bearing large boulders on their surfaces, occur in Aberdeenshire. Beneath the gravel of these mounds the author has found beds of sand and clay, containing marine shells, generally broken, such as *Nucula tenuis*, *Leda pygmæa*, *Lucina ferruginosa*, *Cyprina Islandica*, *Mactra*, *Pecten*, and *Mangelia*.

At higher levels, to the elevation of 800 feet at least, Mr. Jamieson has found striated pebbles and boulders, but unaccompanied by deposits similar to the above. The last change of level in Aberdeenshire seems to have been one of depression, indicated by beds of peat passing below the sea at various places between Aberdeen and the Moray Firth.

3. Mr. Kennedy Macnab, of Inverness, communicated, in a letter to the Secretaries, the fact of flint arrow-heads and whelk-shells having been found at the depth of about 3ft. 6in. beneath the surface of a moss, covered with wood, in the parish of Abernethy (Inverness and Elgin).

4. Mr. Richard Mason, of Tenby, in a communication to the Secretaries, offered a *résumé* of the evidences, both traditionary, historical, and physical, of—1st, the probable depression at some pre-historic period of an extensive tract of country, covering the site of the Bristol Channel and Cardigan Bay; and 2ndly, of the more recent elevation of the land in the neighbourhood of Tenby, South Wales; the elevated district being apparently confined to that lying on the carboniferous limestone. Evidences of a comparatively recent depression of the Cardiff area was also alluded to.

March 10th.—1. "On the Geology of the Gold-fields of Victoria." By A. R. C. Selwyn, Esq., Geologist to the Colony of Victoria. (In a letter to Professor Ramsay, F.G.S.).

The author stated, that in the Colony of Victoria, from a line east of Melbourne to some distance west of that place, he has traced a succession of fossiliferous palæozoic rocks, commencing with schists, much cleaved and contorted, and containing *Lingulæ* and *Graptolites*, passing through a series of schists, and sandstones with *Trilobites* and many other fossils characteristic of the lower, middle, and upper Silurian series of Britain, and terminating with Devonian and carboniferous rocks; and he remarked that the younger or Oolitic (?) coal-bearing beds on the west rest unconformably on the palæozoic rocks. A list of about sixty genera of Silurian fossils, including many new species was appended.

The gold-bearing quartz-veins of the Silurian rocks appear to the author to be dependent more on their proximity to some granitic or other plutonic mass than on the age of the rocks in which they occur. Quartz veins do not appear to traverse the Oolitic (?) coal-rocks, which are of newer date than the granites of this district.

The author's observations refer chiefly to Bendigo, Ballaarat, and Steiglitz gold-fields, where *Graptolites* and *Lingulæ* occur in the schists, which are traversed by the gold-quartz-veins. The granites here do not contain gold; and though they have altered the slate-rocks at the line of junction, yet they do not seem to have affected their general strike or dip, but appear to have themselves partaken of the movements which have placed these Silurian rocks in their present highly inclined and contorted positions, and given them their very uniform meridional direction.

Mr. Selwyn recognises gold-bearing drifts of three distinct ages. The lowest contains large quantities of wood, seed-vessels, &c., at various depths, to 280 feet, and is associated with clays, sands, and pebbles. These are overlaid by sheets of lava. A more recent auriferous drift, containing also bones of both extinct and living marsupial quadrupeds, overlies these lavas in some places; in others it rests on the older drifts; and at Tower Hill, near Warnambool, marine or estuary beds of probably the same age are overlaid by volcanic ashes. A third, and still more recent gold-drift, is found on the surface, overlying indifferently any of the older deposits.

The gold is found at the base of these drifts or gravels, which are the result of the immediate waste, by atmospheric and fluviatile action, of older masses, and have not been far transported. The largest amount of gold is found in the drifts near the Silurian schists. The author believes that there is every probability of gold deposits existing under the greater portion of the lava-plains of the region to the westward.

Mr. Selwyn also described a cave which he had discovered in the basaltic lava of Mount Macedon, a few miles north of Melbourne, and in which he had found bones of many living species of mammals, including the "devil" of Tasmania, and the Dingo or native dog. The cave is about 1,000 feet above the sea-level, and thirty miles inland.

2. "Notes on the Gold-fields of Ballaarat, Victoria." By Mr. John Phillips, C.E., Surveyor in the Government Service of Victoria. Communicated by Sir R. I. Murchison, V.P.G.S.

All the Victorian gold-fields are near granite, and some are on it. The granite at Ballaarat is fine and even-grained, and the schists lie against it. Between these rocks the junction is abrupt; there is little or no gneiss, and no phorpyritic or other veins were observed. The schists are greenish, and are occasionally chloritic, micaceous, aluminous and siliceous, and are traversed by quartz-veins, from less than an inch to one foot in thickness. The schists in the upper portion are more quartzose and contain oxides of iron; lower down they are more aluminous and contain pyrites. Their strike is rather uniform; nearly coinciding with the true meridian, while the cleavage and quartz-veins are not regular in strike. The workings at Ballaarat have exhibited a section of 300 feet in thickness, consisting of gravels, sands, clays, and trap-rocks. The oldest drift, or gravel—a beach-like conglomerate—is found, not in the deep section, but on the surface of the schist country. It is regarded as of marine origin by the author, and is composed of quartz, and contains gold at its base. Another drift has been deposited in gullies cut through the oldest drift and deep into the schists. This also is auriferous, and is covered by an ancient humus, which, in the deep section, is found to contain stems of trees, and to be covered over by a trap-rock enclosing upright trees. This fossil wood is usually but little altered in its texture and ligneous qualities; its colour is changed from that of red birch to cocoa or lignum-vitæ. But some of it has passed into jet; and both the charred and uncharred woods have much bright pyrites in them. The flora of this old land-surface resembles that of the present day.

This first trap is covered by green and brownish clay and sand, which are succeeded by another trap, having a line of charred vegetable matter at its base, and also having a similar covering of clay and sand. These clay and sand deposits are regarded by the author as being of lacustrine origin; the volcanic rocks having dammed up the old river-courses that formed the gully-drifts, and caused the drainage water of the region to be accumulated in lakes.

The next deposit is a coarse ochreous quartzose drift, considered by the author to be the effect of some sweeping deluge; and this is also overlaid by a third bed of trap-rock, with the charred remains of a forest intervening. This trap is covered by a mottled clay of pure quality, also regarded as lacustrine.

A fourth trap succeeds, covered by a superficial quartzose drift (of diluvial origin, according to the author), and lying on one side of the schistose hills, which are clearly denuded on the other.

In the basin of the Yarrowee, which is covered chiefly with this gravel, the author traces the run of the "gold leads" or old gullies, which have only an approximative resemblance to the ramifications of the present river. These ancient gullies or leads had a very uniform fall, which, from the smallness of the contents of the gullies, must have been as rapid as 16 in 1,000, while the fall of the present Yarrowee has only a fall of 8 in 1,000.

Mr. Phillips urges that all the basin between the gold-leads may be wrought by the aid of the water power of the Yarrowee; a thousand horse-power being now allowed to run waste, which, by means of reservoirs, could be made available.

The author adds that silver-nuggets have been reported on good authority to have been found within thirty miles of Ballaarat. He further observes, that, whilst surveying the district, oscillations of the spirit-bubble indicated a rocking of the earth; and that the country in places sounds hollow, like a wooden bridge, horses even noticing it in passing.

3. "Notes on the Gold-diggings at Creswick Creek and Ballaarat." By Mr. W. Redaway. Communicated by Sir R. I. Murchison, V.P.G.S.

Mr. Redaway noticed first the "bluestone" or concretionary basaltic lava at Creswick Creek, which composes also the rough bouldered surface of the country to a great extent. In the plains formed of this volcanic rock, small lakes or water-holes, from 3 to 12 feet in diameter, are in some places frequent.

At Creswick Creek the different diggings perforate varying thicknesses of the bluestone, from 17 to 20 feet. Under this is 30 feet of solid clay; then darkish-coloured quartzose gravel, with abundant remains of wood, to a depth of about 80 feet; and under this the "gutters," "leads," or "runs" of auriferous quartzose, gravel—or "wash-dirt"—are met with on the surface of the slate or on pipe-clay. The pits vary considerably in the sections they afford.

The fragments of wood in the gravel are of all sizes, from tree-trunks, 3 or 4 feet in diameter, to branches and twigs; and this drift is throughout impregnated with woody particles, giving it a black appearance, especially towards the bottom. The cones of the "honeysuckle," or *Banksia*, have been found not unfrequently in this drift. These are very brittle, but the wood is often well preserved. Thin horizontal layers of very hard rock are imbedded in the gravel.

Some of the "gutters" or "leads" were traced by the author on plans showing their course beneath this drift across the present gullies and from hill to hill; especially the "Black Lead" and the "White Lead," underlying Little Hill, one of them having a branch from under Clarke's Hill, and both uniting before passing under Slaughter Yard Hill.

At Ballaarat, Mr. Redaway observed, in a pit on Sevastopol Hill, two layers of bluestone (the second bed about 80 feet thick) above the gold-drift or "wash-dirt," together with stiff clays and quartzose gravels. Here the author traced some gold-runs—the "Frenchman's Lead," "White Horse Lead," and "Terrible Lead," running parallel to each other in a direction transverse to that of the present gully, and from hill to hill. Like all other "leads," these rise generally in the neighbourhood of a quartz-vein (or "quartz-reef"), are shallow at first, 2 or 3 feet in depth, and gradually get deeper.

4. "On the Gold-diggings at Ballaarat." By H. Rosales, Esq. In a letter to W. W. Smyth, Esq., Sec. G. S.

"By the aid of machinery, and through the alteration of the mining regulations granting extended claims, the old ground has been profitably re-worked; and, by the introduction of the frontage-system, which, according to the difficulties to be overcome, grants extensive claims on new ground, the present 'leads,' most of which are N. W. of the Gravel Pits, under the townships, are advantageously worked. The amalgamation of three or more claims is also allowed, the miners having then to put down only one shaft.

"The engines most in use are stationary, of from 15 to 20-horse power, with winding and reversing gear. To the end of the winding-gear shaft is attached the crank for the pump, and the motion is also taken to drive a puddling machine, which is nothing but the *arrastra* working without mercury. The depth of sinking averages about 300 feet, of which in some instances there are as much as 200 of basalt to be cut through.

"At the junctions of the Frenchman's and White Horse Leads, in the Eldorado, the remains of a tree were found in an undisturbed position, with the roots fast in the wash-dirt; and it might be interesting to you to know that at Poverty Point the deep channel, with a N.W. strike, is crossed at about 140 feet higher by the shallow channel, which has a strike of N.E. by E., and which again in its turn is crossed, at a level of 20 or 30 feet still higher, by the present water-course, the strike of which is W."

5. "Notes on some Outline-drawings and Photographs of the Skull of *Zygomaturus trilobus* of Macleay, from Australia." By Prof. Owen, F.R.S., F.G.S.

About a month since Prof. Owen received from Sir R. Murchison seven photographs, three of which are stereoscopic, of perhaps the most extraordinary mammalian fossil yet discovered in Australia.

These photographs, with a brief printed notice of their subject by William Sharp Macleay, Esq., F.L.S., and some MS. notes by J. D. Macdonald, M.D., R.N., had been transmitted to Sir R. Murchison by His Excellency Governor Sir W. Denison, from Sydney, New South Wales; and by request of Sir Roderick the Professor brought the subject under the notice of the Geological Society of London, to whom Sir Roderick desired to present the photographs on the part of His Excellency Sir W. Denison.

Professor Owen had some weeks previously received from George Bennett, Esq., F.L.S., of Sydney, outlines of the same fossil skull, made by him on the reception of the specimen by the authorities of the Australian Museum at that town; and the Professor had penned notes of his comparisons of these sketches before receiving the photographs and descriptions of the fossil skull from Sir R. I. Murchison.

This unique and extraordinary skull of a probably extinct mammal, together with other bones, but without its lower jaw, were found at King's Creek, Darling Downs—the same locality whence the entire skull and other remains of the *Diprotodon* have been obtained.

Mr. Macleay has desbribed the fossil under notice as belonging to a marsupial animal, probably as large at an ox, bearing a near approach to, but differing generically from, *Diprotodon.* He has named it *Zygomaturus trilobus.* The skull has transversely ridged molars, and a long process descending from the zygomatic arch, as in the *Megatherium* and *Diprotodon*, and exhibits an extraordinary width of the zygomatic arches. The skull at its broadest part, across the zygomata, is 15 inches wide, and is 18 inches long. In *Diprotodon* the skull is about 3 feet long by 1 foot 8 inches broad: so that while the latter must have had a face somewhat like that of the Kangaroo, the *Zygomaturus* more resembled the Wombat in the face and head.

Prof. Owen stated that, from the evidences afforded by the photographs, he finds the dentition of this upper jaw to consist of three incisors and five molars on each side, of which the first appears to be a premolar and the rest true molars, thus, $i.\ \frac{3-3}{\quad}$, $c.\ \frac{0-0}{\quad}$, $p.\ \frac{1-1}{\quad}$, $m.\ \frac{4-4}{\quad}$; agreeing, in this formula, with *Macropus* and *Diprotodon*, The modifications of this dentition resemble those of the latter genus in the retention of the premolar, after the last true molar has come into its place, and in the superior size of the first, as compared with the second and third incisors. He then described in detail the sockets of the incisors, and the form and conditions of the molar teeth, which are highly characteristic of the marsupiality of this huge and most strange extinct quadruped. The cranial characters which were next described, equally elucidate this affinity. The peculiar facial bones were then described in detail; that portion in advance of the orbits forming, as it were, a short penduncular appendage to the rest of the skull, increasing in a remarkable manner in both vertical and lateral extent as it approaches the muzzle, but not offering any evidence of having borne a nasal horn, as thought to be probable by Mr. Macleay. The cavity of the nose is divided by a bony septum—a character which Prof. Owen has lately found to exist also in a rare species of living Wombat—to a much greater extent than in other known marsupials. Wholly concurring in Mr. Macleay's conclusions as to the marsupial nature of the fossil in question, Prof. Owen does not think that it exhibits evidences of a generic distinction from *Diprotodon*. The Professor suggested, however, that probably the lower jaw, when found, may show some peculiarities of dentition and proportions similar to those on which he has founded the genus *Nototherium*.

MEETINGS OF FIELD CLUBS.—Three of the West of England Natural History Field Clubs have arranged to meet at Ledbury, Herefordshire, on the 3rd of June —viz., the Herefordshire (Woolhope), the Worcestershire, and the Malvern. Invitations will also be sent to the Field Clubs of Gloucestershire (the Cotswold), Warwickshire, and Tyne Side.

REVIEWS.

Geology made Easy, or the Old and New World. By H. SMITH EVANS.
London: Read & Co. Small 4to.

Two kinds of books there are which should ever be written as well as possible, but of one of these kinds we have an abundance in which the rule is not followed. We confess we never took up a book with kinder feelings towards it than we did the little yellow-covered work before us: we liked its appearance and we liked the title, "Geology made Easy," and we even overlooked the error in its secondary title, and good-naturedly mistook the flourish for an *S.* We saw at a glance clearly printed pages, modest looking lithographs, and an accumulation of what appeared to be facts, and we sat down to read it through in the expectation of being thoroughly delighted. Inaccurate in language—subjected, we should think, to no revision through the press — and with statements most loosely and incorrectly made; we put the book down with a feeling of actual pain. With repetitions of such blunders as "stratums" and "modules," with "trebolite," and other instances of mis-spelling, impossible to reconcile even with the phonetic system,—with facts so oddly stated, as one, for instance, in the table of intensity of winds, where a brisk gale of fifteen miles an hour is called pleasant and one of twenty miles an hour "very ditto," with others so much at variance with what geology teaches us, as that at page 70, where we are informed of the probability of the Lias having undergone the action of fire, and of that formation being the sepulchre of the Wealden Iguanodon: with these and other glaring instances of carelessness before us, we must say, that, far from making it easy, it is, we think, making geology very hard for even a geologist to understand. Still a book of the sort this assumes to be is wanted, and the idea was good. Our sincere advice to the author is to get some competent Geologist to revise the facts, and to pay more attention to the grammatical rules and requirements of the English language, and then we can assure him he will find no one more ready than ourselves to promote the sale of his little book. But in justice to those readers who trust to our judgment and advice, we cannot recommend this edition.

The Canadian Naturalist and Geologist. Vol. ii., No. 4, Sept., 1857.

THIS interesting number contains an account of the eleventh meeting of the American Association for the Advancement of Science.

Papers were read before the section of Natural History and Geology, by Mr. Snell, "On the quantitative assay of chromium by the blow-pipe;" by Prof. Dawson "On some curious flexures in the Broad-top coal-strata of Pennsylvania attributed to lateral pressure;" and one by Sir. W. E. Logan "On the great series of Canadian metamorphosed rocks," which the author of this paper had named respectively the Huronian and Laurentian series of Canada. This is a paper worthy of perusal by those who take part in the present sub-silurian enquiry, and the tracing out of the remnants of that oldest world whose fragments are being found among the so-called azoic rocks, and driving that term bit by bit out of its geological territory. The Huronian rocks, according to Sir William, are often nearly vertical, and are disposed unconformably under the Silurian Formation, the lowest strata of which are made up of the *debris* of these unquestionably older rocks.

Papers were also read by Mr. J. Sterry Hunt "On the origin of magnesian rocks;" by Prof. G. H. Cook "On the subsidence of the land on the sea-coasts of New Jersey and the adjoining States;" and by Mr. Hunt "On the metamorphism of sedimentary rocks."

The two interesting letters on the crystalline rocks of the North Highlands of Scotland by our own eminent geologist, Sir R. I. Murchison, with notes on their fossils by Mr. Salter, have made the Americans partially acquainted with the subject of Sir Roderick's last communication to the Geological Society on the metamorphism of the Scotch Silurian strata.

Among the other valuable papers which our space will not permit us to notice at length, are those by Professor Silliman "On the dressing of metallic ores;" Sir W. E. Logan "On the subdivision of the Laurentian rocks of Canada into two great groups characterized by the presence of much lime or by the comparative absence of that mineral compound;" Prof. Chapman "On the deposition of native metals in vein-fissures by electro-chemical agency, and on the saltness of the sea;" Prof. Dawson "On newer pliocene fossils of the St. Lawrence Valley;" Prof. Ramsay "On the succession of fossils in British rocks;" Prof. Pierce "On the formation of continents;" Prof. Guyot "On the physical geography of Africa;" Prof. Hall "On the direction of the currents of deposition and source of materials of the older Paleozoic rocks;" and Prof. Swallow "On the geological survey of the Missouri, &c." Many of the papers in the other sections of the Association, and some of the extraneous articles in this number of the Magazine, are not without interest to the geologist.

PANORAMIC VIEW OF NORTH WALES, FROM

COLORED GEOLOGICALLY BY ANDRE

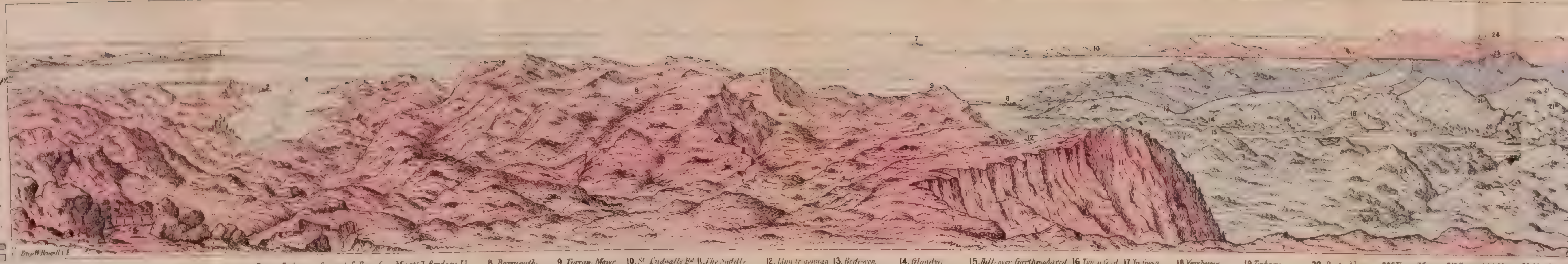
ALTITUDES IN FEET

Above Level of Sea.

Summit	2914 Ft
Mynydd Moel	2817
The Saddle	2655
Mynydd Pen y Coed	2504
Craig Alas	2041
The Pass	1902
Llyn y Gafr	1335
Mynydd Gwerwyn	1750
Stony Mts	1730
Moel ddu	1562
Pengarn	1510
Bwlch Coch	1200

GEOLOGICAL REFERENCE.

Cambrian Grits & Rovle Slates	▭
Lingula Flags	▭
Llandeilo & Caradoc or Bala Beds with imbedded igneous rocks	▭

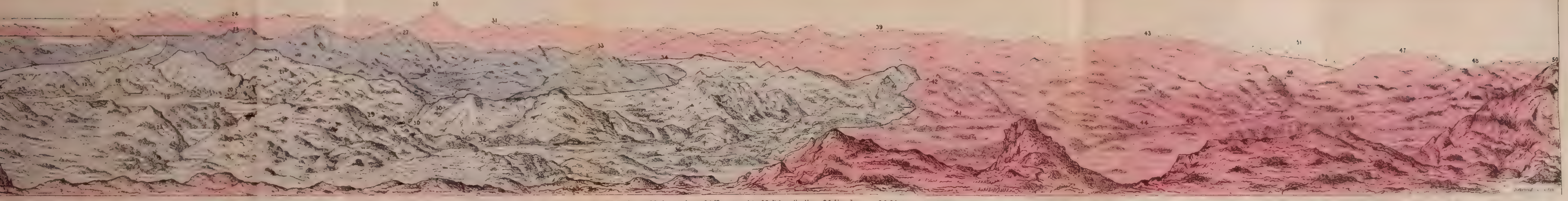


Drg W Howell L

1. Pembrokeshire
2. Towyn
3. Craig Aderyn
4. Dysynwy River
5. Seat on Summit of 'Cader Idris'
6. Pen y Garn Mount.
7. Bardsey I.s
8. Barmouth.
9. Tyrrau Mawr
10. St Ludwalls Bd
11. The Saddle
12. Llyn Cregennan
13. Bodowen
14. Glandwr
15. Hill over Garthynghared
16. Tyn y Coed
17. Ty Gwyn
18. Varchwys.
19. Turbary.
20. Pont ddu
20a. Vigra Mine.
21a. Clogau Gold Mine
25. Llanllech
21. Hendreforeon.
22. Ty Gwyn or Abergwynant.
23. Vale of Ty Gwyn
24. Anglesea.

ORAMIC VIEW OF NORTH WALES, FROM THE TOP OF CADER IDRIS.

COLORED GEOLOGICALLY BY ANDREW. C. RAMSAY, F.R.S, & G.S.



THE GEOLOGIST.

MAY, 1858.

THE PHYSICAL STRUCTURE OF MERIONETHSHIRE AND CAERNARVONSHIRE.

By Professor A. C. Ramsay, F.R.S. and G.S.

The view from the summit of Cader Idris is one of the most magnificent in Wales. Turning to the south, the landscape consists of a series of rolling hills, stretching as far as the eye can reach, in smoothly swelling outlines; and it is impossible not to be struck with the circumstance that, though some rise higher than others, they maintain a sort of average height, accompanied by a general gentle inclination towards the sea. Through this broad undulation innumerable valleys have been excavated. The hills have not been formed merely in consequence of disturbance of the strata; but, through the outcropping and smoothed edges of disturbed strata, many great and small valleys have been cut by old marine denudations, atmospheric disintegrations, and the action of running water. The general uniform character of the outlines of this country is due to the sameness of the rocks, which, in the main, consist of slates, occasionally varied by hard or interstratified bands of sandstone, the whole belonging to that part of the Silurian series known as the Caradoc or Bala beds, and the rocks immediately overlying.

Turning northwards, a change in the character of the landscape becomes at once apparent. The mountains are broken and rugged. The summits of the Arans, the great swelling mass of Rhobell-fawr, the cliffs of Rhinog-fawr and Rhinog-fach, that guard the pass of

Bwlch-drws-ar-Dudwy, the bold outlines of the Arenigs, the Moelwyns, and Cynicht, all meet the eye almost at a glance; and, far in the distance, the peak of Snowdon sharply pierces the air, rising to a height of 3,571 feet above the sea. The reason of the extreme diversity of the scenery from Cader Idris northwards is, that the greater proportion of that district of Wales is formed of numerous interstratifications of slate and felspathic traps and ashes, mingled with large intrusive felspathic bosses and lines of greenstone. The whole of these have been disturbed, and thrown into numerous sweeping anticlinal and synclinal curves; and, all being alike subject to denudation, portions of the softer slaty beds have been more rapidly worn away; while, in great part resisting denudation, the igneous rocks and some of the grits stand out in bold relief, forming great part of the cliffs of Cadir Idris, the Arans, the Arenigs, the Moelwyns, Y-Glyder-fawr, Carnedd Dafydd, Carnedd Llewelyn, Moel Siabod, Moel Hebog, and Snowdon. Gazing at this sea of mountains, the uninstructed geologist would find it difficult to believe that the rugged Snowdonian range that runs from Moel Hebog by Carnedd Llewelyn to Conway is composed of rocks which are the equivalents of the strata occupying the comparatively low-lying hills of the Bala district, east of Arenig; but such is, nevertheless, the case.

It is impossible to give a perfect idea of all this unless in the country itself, or, at all events, with a geological map and sections before us; but, in default of these aids, some idea of it may be obtained by the help of the accompanying panoramic diagram, drawn by Percy W. Hewgill, Esq., C.E., which my intimate knowledge of the country has enabled me to colour geologically.

The view is taken from the summit of Cader Idris, which consists of an amygdaloidal greenstone, that slopes down the mountain towards Llyn-y-Cae. Under it are masses of felspathic trap, and long lines of greenstone, interbedded with altered slates, forming the steep northern cliff of the mountain, and overlooking the high valley that lies between the cliff and Mynydd Gader. That valley itself is formed almost entirely of felspathic ashes and conglomerates, with interbedded lines of greenstone, the whole dipping under the igneous rocks of the cliff. The same rocks stretch north-east, and form the peaks of Aran Mowddwy, and Aran Benllyn. Underneath these lie the Lingula-flags —so called from the prevalence in them of that oldest known brachiopod, *Lingula Davisii.* Near Dolgelli they also contain a crustacean, *Hymenocaris vermicauda.* From Mynydd Gader they stretch across the Barmouth estuary, being in many places pierced by felspathic traps and lines of greenstone; finally they rise on the flanks of the great boss of Cambrian grits that form the centre of the "Merionethshire anticlinal" of Professor Sedgwick, which extend from Barmouth to Harlech and the neighbourhood of Ffestiniog.

Down the Bala valley, and along the upper course of the river Wnion towards Dolgelli, there runs a great fault. It is a downthrow to the north-west, and, on its western side, all the rocks of Cader Idris and the Arans are repeated. Thus, from Penmaen to the Arenigs we have a repetition of the interbedded felspathic traps and ashes of the Arans, and underneath them the Lingula-flags again crop out between the west sides of Arenig and the Cambrian strata of Dol-melynllyn and Trawsfynydd. These Lingula-flags circle entirely round the south-east, east, and north sides of the Cambrian boss, and pass into overlying strata, which are imperfect representatives of the Llandeilo-flags of South Wales. These, in turn, are themselves encircled by a great crescent-shaped mountain-ring of interbedded volcanic felspathic traps and ashes, already described, of which Cader Idris, the Arans, Arenigs, and Moelwyns, form a chief part. Beyond Arenig, these igneous rocks stretch north to Llyn Conwy, from thence striking westward to the Manods and the Moelwyns, beyond which they suddenly die out before reaching Traeth-bach.

It has been already stated that beneath the Lingula-flags the Cambrian grits constitute the centre of the Merionethshire anticlinal. They form one of the most rugged tracts of Wales. The centre of the anticlinal is in Gors-goch, north of Llawllech, and east and west, north and south from this centre, the rocks dip steadily. Walking up the road to Trawsfynydd, the instructed eye can readily see, on the cliffs of Rhinog-fawr and Craig-ddrwg, the great terraced lines of hard grit dipping westward; and, on the opposite hand, the same Cambrian strata dipping east in the broken slopes of Craig-y-Penmaen. From bottom to top, the masses of strata succeed each other, like, as it were, the concentric coats of an onion. The central boss of Cambrian grit throws off on its flanks the superincumbent Lingula-flags, which are, in their turn, overlaid by another casing of slates, associated with the interbedded igneous series.

No fossils have yet been found in the Cambrian rocks of Merionethshire. Bands of purple slate occur in them; but in this district they have never been worked to profit. Workable slates of an inferior quality here and there occur in the Lingula-flags, together with copper-lodes, which are frequently worked, and as frequently abandoned. At Cwm Eisen, gold has also for a long time been extracted at intervals from a lode of quartz, though never with a steady profit; and, a few years ago, much sensation was excited in the mining-world by what were, at the time, considered promising discoveries of that metal at Dol-y-ffrwynog, the Clogau, Prince of Wales, and the Cambrian mines, and in various other localities. This fact is of scientific interest, because in the Ural, South Australia, Canada, and other parts of the world, gold occurs in rocks of the same general age, and apparently under the same circumstances. At Dol-y-ffrwynog, the quartz gold-bearing vein traverses a talcose schist, which is a metamorphosed part of the Lingula-flags, intimately associated with neighbouring ramifying intrusive masses of greenstones; and here, for a time, gold was found in such quantity, that in the lode itself it was visible, speckling the surface of the quartz. The greenstone that is intruded into this part of the Lingula-flags, is probably connected underground with the rock of Rhobell-fawr, which itself forms by far the largest mass of greenstone in Wales. From Dolgelli it spreads, in nearly an unbroken sheet of eight or nine miles in length, to the upper part of the river Mawddach; and at Rhobell-fawr it is more than two miles wide, rising in great broken, and bare undulations to the very top, near which it is overlaid by a strip of highly porcelained slate.

On the south-east side of Cader Idris, and east of the Arans, are beds of black slate, forming probably beds of passage from the Llandeilo flags to the Bala beds. In places they contain *Orthis Actoniæ, O. biforata, Leptæna quinquecostata*, with species of *Asaphus, Ampyx, Cybele*, and other fossils. These, in turn, are overlaid by undoubted Caradoc or Bala beds, in the midst of which lies the well-known Bala limestone, which, beginning at Dinas Mowddwy, in interrupted faulted lines, stretches north by Bala across the broken hills south of Cerrig-y-Druidion, and from thence westward to Penmachno. Throughout this course, on two or three horizons, this highly fossiliferous limestone is underlaid by certain thin bands of felspathic volcanic ash. The limestone itself is sometimes slightly ashy.

It was long ago proved by Professor Jukes and Mr. Selwyn, that, from the physical structure of the country, the fossiliferous calcareous ash in the valley of Dolwyddelan, is the precise equivalent of the Bala limestone, and the great mass of felspar-porphyry that lies below this ash, between Dolwyddelan and Yr Arddu, is clearly connected with the same set of volcanic causes that produced the thin volcanic beds underneath the limestone at Bala. The western end of the Dolwyddelan porphyry is only separated from the great masses of porphyry that form the chief components of the Snowdonian range by a narrow anticlinal axis of sandstone and slate, full of the ordinary Bala fossils. The rocks of Dolwyddelan lie, indeed, in an elongated basin, which is an outlier of the greater basin of which Snowdon forms the centre. This larger basin is well worthy of notice. If we follow the geological lines from Moel Hebog to Carnedd Llewelyn, we find, on a great scale, that the structure of the country precisely corresponds to the minor basin of Dolwyddelan. On the south, east, and west of Moel Hebog, there are fossiliferous sandstones of slates of the Bala beds, overlaid by felspathic porphyry, on which are thick beds of calcareous ash, forming the summit of the mountain, and corresponding precisely to the ash of Dolwyddelan. It is therefore, in part, at least, the equivalent of the Bala limestone. The porphyry of Moel Hebog ranges north to Snowdon in an unbroken line, and there, again, between Snowdon and Twll-du, below Y-Glyder-fawr, it is overlaid by the very same ash, which in places, as on the top of Snowdon, becomes partially slaty and fossiliferous. Another patch of the same strata lies in the valley of Nant Gwynant, surrounded by the same porphyry. The basin of volcanic rocks is here over five miles wide, from the hills on the east side of Nant Gwynant, where the rocks dip N. W. to the Pass of Llanberis, where they dip S. E. All these Snowdonian porphyries are true Silurian lava-beds, accompanied by volcanic ashes of the same period. They are perfectly interbedded with fossiliferous strata; and it is worthy of remark that the slates on which the porphyries rest have been altered at points of contact by the overflowing melted masses, whereas the slaty beds that rest upon them, having been deposited on a cooled surface, are unchanged by heat.

Between Snowdon and Y-Glyder-fawr and Menai Straits, blue slaty Silurian strata rise to the north-west. The base of these, interbedded with grit, forms the Lingula-flags, beneath which lie the Cambrian grits and purple slates, in which are the great slate-quarries of Llanberis and Penrhyn.

Part of the foregoing remarks show that, in the lower Silurian epoch in what is now Wales, there have been two periods of volcanic activity. The oldest of these, during the deposition of the Llandeilo flags, is marked by the interbedded porphyries and ashes of Cader Idris, the Arans, the Arenigs, the Manods, and the Moelwyns. The second, which occurred during the Caradoc or Bala period, is separated from the older porphyries by from 4,000 to 6,000 feet of intervening strata of the Bala beds, in the higher parts of which lie the porphyries and ashes that range from Moel Hebog to Conway, and form the great Snowdonian chain. In all these areas no trace of the original craters remain from which the volcanic products found vent. These slates and sandstones, with all their interbedded igneous rocks, are so old, and have been so often disturbed and contorted in wide sweeping curvatures after the close of the Lower Silurian period—besides which, the whole country has suffered from such frequent denudations—that all traces of the original forms of the volcanos have long since perished. But, though the craters have disappeared, there are, among the rocks that *underlie* the lava and ashes, many bosses of *intrusive* felspathic porphyries, syenites, &c., and doubtless some of these are the deep-seated nuclei of melted matter, which, underground, were connected with volcanic vents from whence the lavas poured. Examples occur in the syenite of Ffestiniog, the quartz-porphyry of Llyn Padarn, and in the Rivals and other intrusive bosses that give such a beautiful outline to the long promontory that forms the north horn of Cardigan Bay.

THE SPIRIT OF GOOD BOOKS.

NOTICES OF THE VOLCANIC ROCKS AND GEYSIRS OF ICELAND.

EXTRACTED FROM LORD DUFFERIN'S "LETTERS FROM HIGH LATITUDES."

By the REV. J. E. VAUX, A.M.

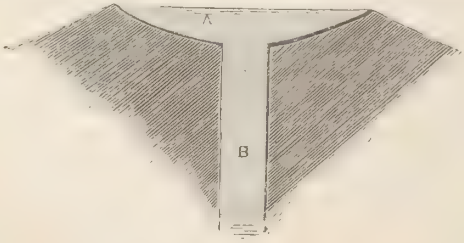
(*Continued from page* 146.)

THE name "Iceland" raises ideas, especially in the winter time, the reverse of cheering; and a subsequent low average of fingers and toes suggests itself as no very unlikely price to pay for witnessing the marvels of Thing Valla. Gentle reader! what think you of an *al fresco* breakfast taken on the plain, "in shirt-sleeves, with a white handkerchief wrapped round the head for fear of the sun, the whole landscape gleaming and glowing in the beauty of one of the hottest summer days I ever remember?" Such is the description given of the summer climate as the party encamped to examine the place more in detail.

Descending the gorge of the Almanna Gja, they went towards the lake. "The perpendicular walls of rock rose on either hand from the flat greensward that carpeted its bottom, pretty much as the waters of the Red Sea must have risen on each side of the fugitive Israelites. A blaze of light smote the face of one cliff, while the other lay in the deepest shadow; and on the rugged surface of each might still be traced corresponding articulations that once had dovetailed into each other, ere the igneous mass was rent asunder. So unchanged, so recent, seemed the vestiges of this convulsion, that I felt as if I had been admitted to witness one of nature's grandest and most violent operations, almost in the very act of its execution. A walk of about twenty minutes brought us to the borders of the lake—a glorious expanse of water, fifteen miles long, by eight miles broad, occupying a basin formed by the same hills, which must also, I imagine, have arrested the further progress of the lava torrent. A lovelier scene I have seldom witnessed. In the foreground lay huge masses of rock and lava, tossed about like the ruins of a world, and washed by waters as bright and green as polished malachite. Beyond, a bevy of distant mountains, robed by the transparent atmosphere in tints unknown to Europe, peeped over each other's shoulders into the silver mirror at their feet; while here and there, from among their purple ridges, columns of white vapour rose like altar-smoke toward the tranquil heaven"

We now follow the party to the spot which has ever been the centre of attraction with visitors to Iceland—the locality of the Geysirs.

"I do not know," writes his lordship, "that I can give you a better notion of the place than by saying that it looked as if, for about a quarter of a mile, the ground had been honey-combed by disease into numerous sores and orifices. Not a blade of grass grew on its hot and inflamed surface, which consisted of unwholesome-looking red clay, or crumpled shreds and shards of slough-like incrustations. Naturally enough, our first impulse on dismounting was to scamper off at once to the great Geysir. As it lay at the farthest end of a congeries of hot springs, in order to reach it we had to run the gauntlet of all the pools of boiling water, and scalding quagmires of soft clay, that intervened, and consequently arrived at the spot with our ancles nicely poulticed. But the occasion justified our eagerness. A smooth, siliceous basin, seventy-two feet in diameter and four feet deep, with a hole at the bottom as in a washing-basin on board a steamer, stood before us, brimful of water just upon the simmer; while up into the air above our heads rose a great column of vapour, looking as if it was going to turn into the fisherman's Genie. The ground about the brim was composed of layers of incrusted silica, like the outside of an oyster-shell, sloping gently down on all sides from the edge of the basin."



Section of a Geysir. A. Basin. B. Funnel.

The chief object which Lord Dufferin and his party had in going so far inland was to see an eruption of the "Great Geysir." As this only takes place at intervals, they were detained some days on the spot, eagerly watching for some premonitory symptom of an approaching crisis. On one occasion a sudden roar, as of subterranean cannon beneath their feet, caused a general rush to the great basin; the noise, however, ceased as suddenly, and there was nothing to see save a slight rippling of the water:—

"Irritated at this false alarm, we determined to revenge ourselves by going and tormenting Strokr. Strokr, or the churn, you may know, is an unfortunate Geysir, with so little command over his temper and his stomach that you can get a rise out of him whenever you like. All that is necessary is to collect a quantity of sods, and throw them down his funnel. As he has no basin to protect him from these liberties, you can approach to the very edge of the pipe, about five feet in diameter, and look down at the boiling water, which is perpetually seething at the bottom. In a few minutes the dose of turf you have just administered begins to disagree with him; he works himself up into an awful passion; tormented by the qualms of incipient sickness, he groans, and hisses, and boils up, and spits at you with malicious vehemence, until at last, with a roar of mingled pain and rage, he throws up into the air a column of water forty feet high, which carries with it all the sods that have been chucked in, and scatters them scalded and half-digested at your feet. So irritated has the poor thing's stomach become by the discipline it has undergone, that even long after all foreign matter has been thrown off, it goes on retching and sputtering until, at last, nature is exhausted, when, sobbing and sighing to itself, it sinks back into the bottom of its den."

On the fourth day of their anxious watch over the Great Geysir, a sudden cry is raised, and with one common impulse they rush towards the basin:—

"The usual subterranean thunders had already commenced. A violent agitation was disturbing the centre of the pool. Suddenly a dome of water lifted itself up to the height of eight or ten feet, then burst and fell; immediately after which a shining liquid column, or rather a sheaf of columns wreathed in robes of vapour, sprung into the air, and, in a succession of jumping leaps each higher than the last, flung their silver crests against the sky. For a few minutes the fountain held its own; then, all at once, appeared to lose its ascending energy. The unstable waters faltered, drooped, fell, 'like a broken purpose,' back upon themselves, and were immediately sucked down into the recesses of their pipe."

The writer does not consider this to have been a first-rate specimen of an eruption. From first to last it did not occupy more than seven or eight minutes, and the extreme height of the column of water did not exceed seventy feet, whereas jets have been actually measured which have attained a height of upwards of a hundred feet.

As to the moving power through whose agency this phenomenon takes place, we must refer our readers to any good treatise on Geology which they may happen to possess.

These "Letters from High Latitudes" contain many other most interesting geological notices, penned in the same agreeable style.

ON SOME NEW PALÆOZOIC CRINOIDS FROM ENGLAND AND SCOTLAND.

By Professor L. de Koninck, of Liége.

(*From the "Bullet. Acad. Roy. Bruxelles,"* 2 *Ser. tome IV. p.* 93.)

(*Continued from page* 149.)

The two following species appear to me to be new, and come likewise from the carboniferous limestone:—

1. Hydreionocrinus Woodianus. *De Koninck.* Pl. IV. fig. 5, 5*a*.

The head of this species is of medium size, sub-cylindrical in form, and terminated at its upper part by a crown composed of fifteen pieces, disposed in a circle, and attached one to another, the central space being occupied by the dome. The *calix*, taken by itself, resembles a little open cup. The *base* is composed of rather small plates, most of which have a point attached to the stem. The *sub-radial plates*, with the exception of that on the anal side, are much broader than long They are very thick and strongly arched, and consequently their sutures are very decidedly exhibited. The *first radial plates* are pentagonal in shape, about a third broader than long, and, like the preceding, rather thick, and separated from each other by a strong groove. The *second radial plates* are also pentagonal, and broader than long. The *axillary plate* is very thick, and furnished with a slight protuberance, and juts outwards. The *brachial plates*, which follow the axillary plate, offer nothing remarkable. The external surface of these plates is indented with little irregular tracings, which make it rough, and *the test* thus resembles shagreen. The *arms*—twenty in number—are composed of cuneiform alternating articulations, and are joined together laterally. I have not observed any traces of pinnules. The little plates of which *the dome* is composed are all ornamented with a prominent tubercle in the middle. Their surface is apparently smooth, their number variable, and their form is generally hexagonal. I have not been able to discover any traces of a horn or proboscis, nor of any anal or buccal opening. It is probable these were situated between the arms, which were placed on the anal or irregular side of the bulb, and that these arms were capable of extension, and of admitting a passage for the food of the animal. The *stem* is rather stout, in comparison to that of most of the other species, among which it is often very slight.

Dimensions—The total length of the bulb is about 40 millemetres; diameter, 25 mm.; length of calix, 12 mm.; diameter of stem, 4 mm.

Affinities and Differences.—This species, by the form of its calix, approaches to H. granulatus, Phil. and H. Phillipsianus, De Kon. It is distinguished from them by the thickness and convexity of its different plates, as also by the rugosity of its surface, which is granulose in the first, and perfectly smooth in the second.

This species was discovered by my excellent friend, Mr. Edw. Wood, in the ferruginous beds of the carboniferous limestone in the neighbourhood of Richmond, in Yorkshire. In dedicating it to him, I only feebly acquit myself of the debt of obligation which I owe to him for the magnificent specimens obtained through his indefatigable researches, and with which he has so kindly enriched my collection.

Explanation of figures—Pl. IV. : —

Fig. 5.—Complete specimen, view of the anal side, slightly restored, and of the natural size. From the collection of Mr. Ed. Wood, of Richmond, Yorkshire.

Fig. 5a.—Dome, slightly enlarged, from a specimen in my collection.

2. Hydreionocrinus Scoticus. *De Koninck.* Pl. IV., fig. 6, 7.

As yet I know of this species only the *calix*. This is rather small, very short, and saucer-shaped. Its *basal plates* are very small, plain, and quadrilateral in form. By their grouping they produce a regular pentagon, in the centre of which may be observed the articular face of a small cylindrical stem. The *subradial plates* are rather large in comparison with the *basal*, which are a little less long than broad, very convex at the centre, thus forming a protuberance sufficient to produce a very decided depression at the base, which remains perfectly concealed when the calix is placed on a flat surface. The first *radial plates* are of pentagonal form, and nearly twice as broad as long. They are slightly less arched than the preceding plates, but in all the species of the same genus they are situated in the same horizontal plane, whilst in the Poteriocrinus there are two which extend beyond the others, as I have already remarked, in 1852, in my "Recherches sur les Crinoïdes" (p. 85). The *anal* plates are small, and a trifle less bowed than the others. The surface of all these plates is perfectly smooth. All the other parts are unknown to me; but the articulation of the base with the stem demonstrates the latter to have been very slight. *Dimensions.*—The length of the calix is only 6^{mm}, its diameter 16^{mm}, that of the base 5^{mm}, that of the stem $1 \cdot 5^{mm}$.

Affinities and Differences.—This species resembles very much my Hydreionocrinus (Poteriocrinus) Maccoyanus, from which, however, it will not be difficult to distinguish it, by reason of the very decided convexity of the different plates of the calix, and the feeble dimensions of the stem.

Position and Locality.—This species has been discovered in the environs of Glasgow, in a black schist, subordinate to the carboniferous limestone with Productus giganteus and Spirifer bisulcatus. I owe the knowledge of it to Mr. Salter, Palæontologist to the Geological Survey of Great Britain, so well known for a great number of important researches.

Explanation of figures.—Pl. IV:—

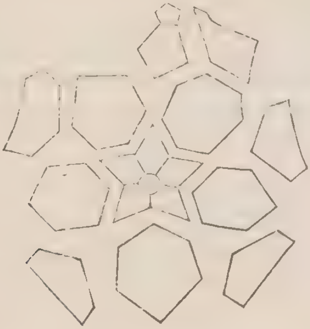
Fig. 6.—Calix, seen from the side of the base, slightly enlarged. In the collection of the Geological Survey at London.

Fig. 7.—The same, seen in profile, of natural size.

The following is the description of a third crinoid, very remarkable for the globular form of its calix, which I dare not place definitely amongst the Hydreionocrini, because it differs in its general character, and because the upper parts of the bulb are unknown to me. I am not more able to class it, in a certain manner, among the Poteriocrini, as it differs from most of them in the form and perfectly horizontal position of its radial plates, which are all, as in the true Hydreionocrinus, placed on the same plane.

3. Hydreionocrinus? globularis. *De Koninck.* Pl. IV., fig. 1—4.

The *Calix* of this pretty species is of ordinary size, and of sub-sphœroidal form, slightly elongated at its base. Its surface is perfectly smooth, and the sutures of the various plates scarcely perceptible, and not indicated by any depression or groove. The *basal plates* are all nearly of the same form, producing by their union a small star with five well-marked rays. The articulation of the stem is situated in the hollow of a small, round, shallow ditch. The *sub-radial* plates are very large and slightly, also, broader than long. Four of them have a tolerably regular hexagonal form; the fifth has seven sides, of which one is welded to the anal plates. The *first radial plates*, those only which are known to me, offer three different forms, the three most distant from the anal side are similar one to another; they are pentagonal, and one a little broader than long. Of the two last, that which is placed on the left of the anal plates is hexagonal, its general form also is not quite the same as that of the other radial plates; that on the right differs totally from these: it is in some sort quadrangular, slightly transverse, and furnished on the left side with a little prolongation corresponding to the second anal plate. The figure below will display, better than any description could explain, the differences which exist between the various pieces.



The two first *anal pieces* only are known to me; the one rather large pentagonal, and a little longer than broad; its upper side is narrow, and supports the second plate, also pentagonal, but extremely small. The thickness of all these plates being considerable, the free space occupied by the animal is thus very much restricted, and the calix, as seen from the upper side, presents but a very narrow opening, and is not unlike, especially in the articular surfaces of the radial plates, the head of the Apiocrinus. Pl. iv. f 4. & 4^a. The stem ought to be small and cylindrical, judging from the small diameter and the form of the impression left by its last articulation on the base of the calix.

Dimensions.—Length of calix 13^{mm}, largest diameter 12^{mm}, diameter of superior edge 8^{mm}, of the stem 2^{mm}; length of sub-radial plates about 6^{mm}.

Affinities and Differences.—The Poteriocrinus nuciformis,* M'Coy, is the only species of crinoid which approaches this, but differing in its more elongated form, and still more in the welding of the two little anal plates at the upper edge of the former, whilst our species has but one in this situation.

Position and Locality.—This species has been found with the preceding in the environs of Glasgow. I know only two specimens, deposited in the Museum of the Geological Survey, at London; and it is also to the kindness of Mr. Salter, that I am indebted for my acquaintance with them.

Explanation of figures.—Pl. IV:—

Fig. 1.—Specimen, of natural size: the anal side.
Fig. 1*a*.—The same, twice magnified: the same view.

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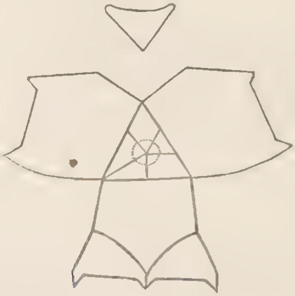
* Descript. Brit. Pal. Foss. Mus. Cambridge, p. 117, Pl. 3 D. fig. 4.

Fig. 2.—The same, of the natural size: the opposite side.
Fig. 3.—The same: the base.
Fig. 3*a*.—The same, magnified: the same view.
Fig. 4.—The same, of the natural size: seen from above.
Fig. 4*a*.—The same, magnified: seen from above.

II. Genus Pisocrinus. *De Koninck.*

Formula.—*Basal plates* 5, united so as to form a triangle; *sub-radial plate* unique, placed at the side of the anal.

Radial plates, known 1 + 5, of which two are large and soldered to the base, and three are small and sub-triangular; one of these last is intermediate between the two large plates and welded to them; the other two are welded partly to the anal plate and partly to the large radial plates.



The *Calix* of the species which belong to this genus is of very small size, and in form globular or conoidal. The base is composed of five small pieces welded together, of which three have a triangular form, whilst the two others are quadrangular. The union of these five pieces forms a sub equilateral triangle, as shown in the diagram above. Each of its two sides supports one large radial plate, of hexagonal shape; these are welded together by one of their sides for the half of their length, whilst the half-length on the opposite side is attached to a single sub-radial plate placed on the third side of the base, and occupying thus the space intermediate between the two great radial pieces, left free by them. This sub-radial piece occupies the anal side of the calix—it is pentagonal. A radial plate of triangular form, but much smaller than the two which are in contact with the base, interposes in the form of a wedge between these latter; two others of a like triangular form alternating with the sub-radial plate. The *stem* ought to be cylindrical, and of rather large dimensions in respect to the diminutive size of the calix, judging from the impression it has left upon the base.

Affinities and Differences.—I would have willingly referred the species I am about to describe to the genus Triacrinus, established in 1839, by the Count von Münster, if that palæontologist did not expressly say that the base of that genus is composed of three triangular pieces,* for it is probable that the disposition of the other plates of the calix is the same in that genus as in that which I here propose.

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* This composition of the base makes me think that the genus Trichocrinus, created subsequently by the learned anatomist of Berlin, J. Muller (Monatsbericht der K. Akad von Berlin, June, 1856, p. 354. and Phys. Abhandl. der K.

Position and Distribution.—I know, as yet, but two species of the genus Pisocrinus, both from the Upper Silurian limestone of the neighbourhood of Dudley, where they have been discovered by Mr. John Gray, of Hagley, whose patient researches have enriched the English Silurian fauna with a great number of remarkable animals.

1. Pisocrinus Pilula. *De Koninck.* Pl. IV., fig. 8—11.

The *Calix* of this species is of the size of a large pea, of which it puts on at the same time the form, saving the truncation, produced by the opening above. The surface is entirely smooth, and also slightly glistening. The *base* is perfectly of the form of an equilateral and slightly broad triangle. The articulation of the stem is placed at the bottom of a rather deep and wide hollow. The *sub-radial* plate, somewhat broader than long, is bounded in its upper part by an obtuse angle, which arrests it at a short distance from the upper edge of the calix. It results from this that the two radial plates, resting upon this plate, are not quite triangular in form (Fig. 8).

The five radial plates have their upper surface deeply furrowed for the reception of the second plate, which should surmount them, but which remains unknown to me. The opening of the calix is almost circular, or rather sub-decagonal through the little slopes existing on the various pieces; that which corresponds to the *anal side* is a little more decided, as is displayed in figure 11.

Affinities and Differences.—This species distinguishes itself from the following by the absence of all ornament on its surface, and by its much more globular form.

Dimensions.—Length about 5^{mm}; diameter of same dimension; diameter of the articulation of the stem 1^{mm}.

Position and Locality.—I know as yet but two specimens of this species; one in the rich collection of Mr. Gray, the other in my own. I owe the last to the kindness of Mr. Lewis of London, whom I have seen with regret abandon the study of palæontology, to the advancement of which he has contributed powerfully by his active researches.

Explanation of figures.—Pl. IV:—

Fig. 8.—Specimen, magnified, view of the anal side. In the collection of Mr. Gray, of Hagley.

Fig. 8 *a.*—The same, of natural size, view of the same side.

Akad. der Wiss., 1856, No. 6, p. 248), for some palæozoic crinoids from the Eifel, is identical with the genus Triacrinus. This is only possible for me to decide by an inspection of the specimens described by von Münster, of which the figure in outline (Beitrage z. Petrefakt., I, pl. I, fig. 4, c) is evidently defective; for, if it were actually the expression of the reality, it would follow that there existed crinoids with three rays instead of five, which is not probable.

Fig. 9.—The same, magnified, view of the opposite side.

Fig. 10.—The same, magnified, view of the side of the base.

Fig. 10 *a.*—The same, of natural size, view of the same side.

Fig. 11.—The same, magnified, view of the opposite side. The letter Z indicates the anal side and the groove for the alimentary canal of the animal.

2. Pisocrinus ornatus. *De Koninck.* Pl. IV., fig. 12, 13.

The *Calix* of this species presents the form of a little truncated cone. The surfaces of the various plates are ornamented with small irregular sculpturings engraved on the test. The *base* offers the aspect of a little cup with edges furnished with three angles, less acute than in the preceding species; its edges are also more raised. The sub-radial plate is rather longer than broad; its upper angle is acute, and is prolonged to the edge of the calix. The small radial plates are of a well-marked triangular form. Their articular surface, destined to receive the second radial plate, is less deeply furrowed than that of the preceding species, but the test of this is thicker. The opening of the calix is pentagonal; on the anal side the groove is more decided (Fig. 13).

Affinities and Differences.—These have been already indicated in the description of the preceding species.

Position and Locality.—This species has been discovered by Mr. John Gray in the Silurian limestone of Dudley.

Explanation of figures.—Pl. IV:—

Fig. 12.—Specimen, magnified, view of the anal side. In the collection of Mr. Gray, of Hagley.

Fig. 12 *a.*—The same, of the natural size, seen from the same side.

Fig. 13.—The same, magnified, seen from above.

THE PRACTICAL APPLICATION OF GEOLOGY IN COAL-SEEKING.

By James Buckman, F.G.S., F.L.S., F.S.A.

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(*Continued from page* 134.)

The case now to be detailed is one which was investigated at Malmsbury, in Wiltshire. At this place the worthy burgesses to whom the land had been bequeathed by king Athelstan had undoubted evidence that a shaft had been sunk for coal on the land in question. This operation was actually performed about a century ago, and, in order to pay the attendant expenses, the whole of the timber from a large estate was felled and sold. *Tradition* said that "the coal had been arrived at, but, in reality, those engaged had been bought off by some proprietors in the Bristol coal-field, for fear the new district coal should come in competition with theirs."* But, besides evidence of this kind, about two pounds of *Lignite* was submitted to my inspection, with the assurance that it burnt like good coal; and the argument founded upon this pseudo-coal was as follows:—"This coal is about two inches thick at about 20 feet from the surface; how thick, therefore, may we not expect it at a hundred yards?" But for fear this should not be deemed conclusive, a bill of sale of some land in the district, many years before the date of this examination, was produced, on which was the statement that "Mining rights were reserved." But I should state that upon inquiry it was found that the said land belonged to the Crown, and I believe that in all Crown lands there is a reservation made of mining rights; thus this, it will be perceived, was no evidence whatever of the presence of mineral matter. These, then, were the foundations upon which the burgesses relied; now for the geological examination.

Upon going to the site of the old workings I soon found that they had been commenced in the Oxford Clay, and, upon examining as much of the contents of the shaft as I found exposed, I became convinced that the opening, of nearly 100 feet deep, as stated by my guide, had not gone through that deposit.

We had, therefore, even less hope of attaining coal than in the previous case, inasmuch as in all probability we should have not merely one, but three thick formations to penetrate before arriving at its usual position—namely, the Lower Oolites, the Lias, and the New Red Sandstone formations. In this instance, then, it became evident that it would have been rash in the extreme to have recommended any operation in search of coal, as, even if it were proved to exist below the formations cited, we could have no evidence of its quantity or value. Still the case itself may serve to show an advance in the opinion entertained of the value of science—the first mining having been commenced under the auspices of a practical miner, while, a century later, all hope and efforts were abandoned at the recommendation of a practical geologist.

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* This is the most common way for accounting for the abandonment of futile coal workings. Sir R. Murchison says:—"Amid all their failures, I never met with an individual who was really disheartened; a frequent exclamation being, 'Ah! if our squires were only men of *spirit*, we should have as fine coal as any in the world.'"—*Silurian System*, p. 328.

Before leaving this part of my subject it may be well to glance at the frequency of wrong conclusions, arising from the presence of local deposits of lignite. In all clay beds slight deposits of carbonized wood may occur, which, once observed by the unlearned, a coal-mining mania springs up—and thus the many futile attempts in the Liassic and Oolitic clays; and it is probable that a famous opening in the Forest Marble clay, about two miles from Cirencester, was first attempted from the occurrence of this material, which is common in this rock*. Here, however, the good people fondly imagined that they had evidence more conclusive to rely upon than the famous Johanna Southcote, who prophesied that coal was there—no doubt, like the rest, having first examined the lignitic testimony. But, alas! even prophecy cannot make coal; and, after penetrating some distance into the Great Oolite, this work was abandoned.

In considering the subject of where coal may be found convenient for working, I might refer to other special instances, but I prefer at present treating only of general principles connected with my subject, and will illustrate this part with an account of coal explorations undertaken by myself in America.

The chief principles which should ever guide us in determining the convenience of working will be the following:—

Depth
Physical circumstances } of Coal.
Quality and quantity

The first of these is an important consideration; as, if too deep to be worked with profit, there is usually an end to the speculation: besides, the probable depth is a matter to be ascertained, if possible, in estimating the cost before the work is commenced. As regards this item, it may be taken for granted that, as the shallow coal gets worked out, recourse will be had to the deeper beds. In the early days of mining, coal could only be won when near the surface; but mines are now worked deeper and deeper, and will be as the price becomes higher. The section (1) may serve to illustrate, (1,2,3) where mining would be futile as being in beds below the coal; (4,5) where mining is practicable, and likely to pay on account of moderate depth; (6) where the matter is doubtful, as being beyond a present paying depth; and (7) where next to impossible, the mineral being beyond our reach.

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* "Black, bituminous, and pyritous shales," (as well as lignite,) says Sir R. Murchison, "resembling beds of the coal formation, are quite enough to lead any common miner to believe that he "smells" the coal; and thus country gentlemen are duped by ignorant men, who often honestly believe what they prophesy. Whether the strata thus resembling coal measures be a mile above or below the geological position of the carboniferous system has never formed part of the education of these speculators."—*Silurian System*, p. 488.

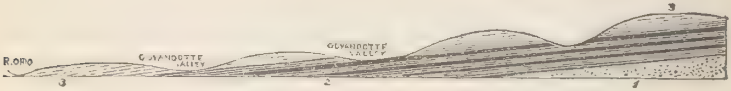
The physical circumstances attendant upon a mine—such as whether its beds are tolerably uniform or have been greatly shattered by faults or dislocations of any serious moment, whether liable to be "drowned out" by water, in which case facilities for getting this fluid away must be duly and carefully considered—these, and other matters of equal moment, in every coal-mining adventure, must be properly weighed.

All these pre-determinations, however, will be materially affected by considerations of quality and quantity, points which can usually be ascertained only by absolute experiment. At the same time, the geologist should never conclude from a mere local examination, but regard with the utmost care and circumspection all the circumstances connected with the field of which the portion or locality under investigation forms a part; as, by strict local inquiry, added to carefully-drawn generalisations, we shall be able to perceive what exists at greater depths than can be attained by the miners' tools.

I now proceed to the details connected with a coal investigation in America, as this course will tend to show that correct principles are universally *practical*, being equally a sure guide in a coal investigation 3,000 miles distant, as in our own land. All the circumstances I have been previously discussing were not only of use theoretically but practically in my field-examination. It being a matter of importance to some gentlemen in England to ascertain whether a large tract of land in Western Virginia, U.S., really possessed the amount of valuable coal which had been stated, it fell to my lot to be dispatched to the locality to report fully upon the subject. After my arrival on the great American continent I made my way with dispatch to Pittsburg, which not only lay in the direction of my labours, but was itself situated in a large coal and iron mining district; and indeed, from its mineral wealth, that city has not inaptly obtained the name of the "Birmingham of America." Here, having become satisfied that the whole geological structure was that of the true coal period, I took my passage in the steamer down the Ohio, a distance of nearly 400 miles, to Guyandotte, a small township on the junction of a river of that name with the Ohio, some 24 miles up which tributary, on either bank, was the ground which I had come to examine. At Guyandotte I got a good starting-point by the discovery that a sandstone there was the equivalent of the "coal grits" of the Staffordshire miners. This sandstone is coarse-grained and calcareous, effervescing readily with acids, but still harsh to the touch from its large quartzose grains. Such calcareous bands are wonderfully persistent in the roof of the coal seams, both at home and in America.

As this bed dipped at a scarcely appreciable angle from the Allegany country towards the Ohio flats, it became evident that in going up the Guyandotte towards its mountain-source, I should meet with older beds; and thus, as I started from the *roof* of the coal, I should expect soon to meet with the coal measures themselves.

SECTION 4.



1. Millstone Grit. 2. Coal. 3. Lower New Red.

Here, then, the river sections greatly exposed the nature of the country, and as the coal commenced on the northern edge of the property it became of importance to trace its southern limits—and by doing so I became acquainted with every seam of coal, as these, one after the other, became exposed in the creeks opening upon the Guyandotte, until ultimately all sign of coal was lost, and a hard rock presented itself, which I could readily identify as the floor of the coal. This peculiar rock was a rough, hard, gritty sandstone, with occasional impressions of such plants as mark our own coal measures—*Stigmaria, Sigillaria, Lepidodendron, Calamites,* Ferns, and other relics of an ancient flora, which differed much less from our own of that period than the American and European floras do from each other at the present day.

By this investigation the limits of the coal were easily determined, and as the seams cropped out on the hill sides, above the river, there could be no difficulty in making out its quantity—the more easily, as the beds were exceedingly regular, not faulted, and the dip but slight from the Alleganies to the Ohio.

It is not here necessary to dwell upon all the interesting facts which presented themselves in the examination of this tract of country; it being well known that the American Continent is exceedingly rich in coal, which as soon as the forest is consumed will be fully developed. By far the greater part of the coal deposit of America is of the same age, and presents a great similarity of attendant circumstances with our own; and, although this country and America are so widely separated by the Atlantic Ocean, no better preparation can be made for studying the great western coal deposits than by obtaining a knowledge of our own Welsh coal-field.

BRITISH FOSSILS, STRATIGRAPHICALLY ARRANGED.

By John Morris, F.G.S.

I. PALÆOZOIC SYSTEM.

(*Continued from page* 142.)

FOSSILS OF THE LINGULA, LLANDEILO, AND CARADOC BEDS—CONTINUED.

Echinodermata.

(*Cystidea*)
- Agelacrinus Buchianus, *Forbes*, Sil. 207.
- Caryocystites Davisii, *M'Coy*, M. G. S. 2, p. 513.
  - granatus, *Wahl.* Sil. 207.
  - ? Litchii, *Forbes*, M. G. S. 2, p. 514.
  - ? munitum, *Forbes*, Sil. 207.
  - ? pyriforme, *Forbes*, M. G. S. 2, p. 515.
- Echinosphærites arachnoideus, *Forbes*.
  - aurantium, *Gyll.* M. G. S. 2. p. 516.
  - balticus, *Eichw.* Sil. 207.
  - granulatus, *M'Coy*, S. F. 59.
  - punctatus, *Forbes.* Sil. 207.
- Glyptocystites Rugeri, *Salt.* Sil. 229.
- Hemicosmites oblongus. *Pand.* M. G. S. 2 p 511.
  - pyriformis, *Buch.* M. G. S. 2. p. 511.

(*Crinoidea*)
- Glyptocrinus basalis, *M'Coy.* P. F. 57.
- Cyathocrinus, *sp.*
- Rhodocrinus quinquangularis, *Mill.* S. S. 764 (*Asteriadæ*)
- Palæaster asperrimus, *Salt.* Sil. 208.

(*Ophiuridæ*)
  - obtusus, *Forbes*, Sil. 208.
- Protaster Salteri, *Sedgw.*

Annelida.

- Aphrodita, *Portl. sp.* G. R. 362.
- Arenicolites linearis, *Hall, sp.* Sil. 14.
- Crossopodia lata, *M'Coy.* P. F. 130.
  - Scotica, *M'Coy.* Sil. 221.
- Lumbricaria antiqua, *Portl.* G. R. 361.
  - gregarea, *Portl.* G. R 361.
- Myrianites Macleayi, *Murch.* Sil. 221.
  - tenuis, *M'Coy.* P. F. 130.
- Nemertites Ollivantii, *Murch.* S. S. 701.
- Nereites Cambrensis, *Murch.* Sil. 221.
  - Sedgwickii, *Murch.* Sil. 221.
  - multiforis, *Harkn.* G. J. 11. p. 476.
- Serpulites Maccullochii, *Salt.* Sil. 222.
  - 3 smooth sp.
- Tentaculites anglicus, *Salt.* Sil. 74.
  - ornatus, *Sow.* S. S. 628.
- Trachyderma, *sp.*

Crustacea (Entomostraca).

- Acidaspis bispinosus, *M'Coy*. S. F. 45.
  - Caractaci, *Salt*. Dec. 7. t. 6.
  - callipareos, *Thoms*. G. J. 13. t. 6.
  - histrix, *Thoms*. G. J. 13. t. 6.
  - Jamesii, *Salt*. Dec. 7. t. 6.
  - Lalage, *Thoms*, G. J. 13. t. 6.
  - unica, *Thoms* G. J. 13. t. 6.
- Æglina binodosa, *Salt*. Sil. 50.
  - grandis, *Salt*. Sil. 53.
  - major, *Salt*. Dec. 7. t. 10.
  - mirabilis, *Forbes*, Dec. 7. t. 10.
- Agnostus limbatus, *Salt*.
  - Maccoyii, *Salt*. Sil. 55.
  - pisiformis, *Brong*. Sil. 45.
  - trinodus, *Salt*. Sil. 223.
- Amphion pseudo-articulatus, *Portl*. G. R. 291.
- Ampyx mammillatus, *Sars*. Isis, 1835.
  - nudus, *Murch*. Sil. 225.
  - rostratus, *Sars*. Isis, 1835.
  - tumidus, *Forbes*, Dec. 2.
- Angelina Sedgwickii, *Salt*. Sil. 53.
  - subarmata, *Salt*. Sil. 53.
- Asaphus gigas, *De Kay*. G. R. 295.
  - læviceps, *Portl. sp*. G. R. 299.
  - laticostatus, *Green*, P. F. 170.
  - Powisii, *Murch*. S. S. 661.
  - rectifrons, *Portl*. G. R. 298.
  - tyrannus, *Murch*. S. S. 662.
- Beyrichia affinis, *Jones*, A. N. H. 16.
  - Barrandiana, *Jones*, A. N. H. 16.
  - bicornis, *Jones*, A. N. H. 16.
  - complicata, *Salt*. Sil. 55.
  - strangulata, *Salt*. P. F. Ap. p. ii.
- Bronteus Hibernicus, *Portl*. G. R. 270.
- Calymene Blumenbachii, *Brong*. S. S. 653.
  - brevicapitata, *Portl*. Sil. 55.
  - duplicata, *Murch*. Sil. 55.
  - obtusa, *M'Coy. sp* S. F. 54.
  - parvifrons, *Salt*. Sil. 53.
- Cheirurus bimucronatus, *Murch. sp*. S. S. 658.
  - cancrurus, *Salt*.
  - clavifrons, *Dalm. sp*. Sil. 225.
  - gelasinosus, *Portl. sp*. G. R. 289.
  - octolobatus, *M'Coy*. P. F. 154.
- Conocephalus invitus, *Salt*. Sil. 47.
- Cybele rugosa, *Portl. sp*. G. R. 302.
  - verrucosa, *Dalm. sp*. Sil. 225.
- Cyphaspis megalops, *M'Coy*. P. F. 143.
- Cyphoniscus socialis, *Salt*. Sil. 225
- Cythere ? umbonata, *Salt*. P. F. Ap. p. ii.
- Dithyrocaris aptychoides, *Salt*. G. T. 8.
- Eccoptochile Sedgwickii, *M'Coy*. P. F. [illegible]
- Ellipsocephalus depressus, *Salt*. Sil. 47.
- Encrinurus baccatus, *Portl. sp*. G. R. 262.
  - multisegmentatus, *Portl*. G. R. 291.
  - sexcostatus, *Salt*. Dec. 7.
- Harpes Dorannii, *Portl*. G. R. 267.
  - Flanaganni, *Portl*. Sil. 225.
- Homalonotus bisulcatus, *Salt*. Sil. 53.
  - rudis, *Salt*. P. F. 168.
  - Vulcani, *Murch. sp*. S. S. 663.
- Hymenocaris vermicauda, *Salt*. Sil. 45.
- Illænus (*Bumastus*)
  - Bowmanni, *Salt*. M. G. S. 2. p. 339.
  - Davisii, *Salt*. Dec. 2. t. 2.
  - Murchisoni, *Salt*. Dec. 2.
  - ocularis, *Salt*. Dec. 2.
  - perovalis, *Murch*. S. S. 661.
  - Portlockii, *Salt*. Dec. 2.
- Leperditia Solvensis, *Jones*. A. N. H. 17.
- Lichas laciniatus, *Dalm*. Pal. t. 6.
  - laxatus, *M'Coy*. S. F. 51.
  - Hibernicus, *Portl*. G. R. 274.
  - nodulosus, *Salter*. P. F. *ap*. p. iv.
- Ogygia Corndensis, *Murch*. Sil. t. 3.
  - Buchii, *Brong*. Sil. 55.
  - Portlockii, *Salt*. Sil. 55.
  - Selwynii, *Salt*. Sil. 53.
  - scutatrix, *Salt*. Sil. 53.
- Olenus bisulcatus *Phil*. Sil. 46.
  - humilis, *Phil*. Sil. 46.
  - micrurus, *Salt*. Sil. 45.
  - scarabæoides, *Salt*. Sil. 46.
- Paradoxides Forchhammeri, *Ang*. Sil. 45.
- Phacops alifrons, *Salt*. P. F. 159.
  - amphora, *Salt*. Dec. 7.
  - apiculatus, *Salt*. Sil. 75.
  - Brongniartii, *Portl*. G. R. 282.
  - conophthalmus, *Beck. sp*. Sil. 225.
  - Dalmanni, *Portl*. G. R. 282.
  - Downingiæ, *Murch. sp*. S. S. 665.
  - Jamesii, *Portl*. G. R. 283.
  - Jukesii, *Salt*. Dec. 7.
  - mucronatus, *Brong*. Dec. 7.
  - obtusicaudatus, *Salt*. P. F. *ap*. p. ii.
  - truncato-caudatus, *Portl* G. R. 281.
- Remopleurides Colbii, *Portl*. G. R. 256.
  - dorso-spinifer, *Portl*. Sil. 225.
  - latero-spinifer, *Portl*. G. R. 236.
  - longi-costatus, *Portl*. G. R. 257.
  - obtusus, *Salt*. Dec. 7. p. 2.
  - platyceps, *M'Coy*. S. F. 44.
  - radians, *Barr*. Dec. 7.
- Sphærexochus mirus, *Beyr*. Dec. 7.
- Staurocephalus globiceps, *Portl. sp*. G. R. 257.
  - Murchisoni, *Barr*. P. F. p. 153.
- Stygina latifrons, *Salt*. Sil. 184.
  - Murchisonæ, *Murch. sp*. Sil. 55.
- Tiresias insculptus, *M'Coy*. S. F. 43.
- Trinucleus concentricus, *Eaton. sp*. Sil. 224. (T. Caractaci, *Murch*.)
  - Gibbsii, *Salt*. Sil. 53.

Trinucleus fimbriatus, *Murch.* Sil. 55.
Lloydii, *Murch.* Sil. 55.
Murchisonii, *Salt.* Sil. 50.
Trinucleus radiatus, *Murch.* S. S. 660.
seticornis, *His. sp.* Sil. 75.
Thersites, *Salt.* Dec. 7. p. 7.

BRYOZOA.

Diastopora heterogyra, *M'Coy.* P. F. 45.
Graptopora socialis, *Salt.* Sil. 47.
Fenestella subantiqua, *d'Orb.* Sil. 203.
Milleri, *Londs.* S. S. 678.
Glauconome disticha, *Goldf.* Pet. 217.
Intricaria obscura, *Portl.* G. R. 326.
Ptilodictya acuta, *Hall.* Sil. 203.
costellata, *M'Coy.* P. F. 46.
dichotoma, *Portl.* G. R. 339.
explanata, *M'Coy.* P. F. 36.
fucoides, *M'Coy.* P. F. 47.
Retepora Hisingeri, *M'Coy.* P. F. 48.

BRACHIOPODA OR PALLIOBRANCHIATA.

Atrypa marginalis, *Dalm.* V. A. 59.
Crania craniolaris. *M'Coy. sp.* P. F. 255.
divaricata, *M'Coy. sp.* P. F. 187.
Discina (*Orbicula*)
crassa, *Hall.* G. J. 7. p. 151.
implicata, *Sow. sp.* S. S. 626.
lævigata, *Münst.* G. R. 445.
oblongata, *Portl.* G. R. 445.
perrugata, *M'Coy.* S. F. 24.
subrotunda, *Portl.* G. R. 445.
Leptæna calcarata, *M'Coy. sp.* S. F. 28.
lævigata, *Sow.* S. S. 629.
lævissima, *M'Coy.* S. F. 27.
quinquecostata, *M'Coy.* P. F. 236.
sericea, *Sow.* T. S. 636.
tenuicincta, *M'Coy.* P. F. 239.
tenuissime-striata, *M'Coy.* P. F. 248.
transversalis, *Dalm.*
Lingula attenuata, *Sow.* Sil. 50.
brevis, *Portl.* G. R. 443.
curta, *Conr.* P. F. 251.
Davisii, *M'Coy.* Sil. 53.
granulata, *Phil.* Sil. 55.
longissima, *Pand.* Russ. Ur. 293.
obtusa, *Hall.* P. N. Y. 1. p. 98.
ovata, *M'Coy.* P. F. 254.
tenuigranulata, *M'Coy.* Sil. 212.
lepis, *Salter.*
plumbea, *Salt.* Sil. 30.
Ramsayi, *Salt.* Sil. 55.
Orthis Actoniæ, *Sow.* Sil. 209.
alata, *Sow.* Sil. 55.
alternata, *Sow.* S. S. 638.
biforata, *Schlot. sp.* Sil. 210.
biloba. *Linn. sp.* S. S. 630.
calligramma, *Dalm.* Sil. 209.
confinis, *Salt.* G. J. 5. p. 15.
costata, *Sow.* S. S. 639.
crispa, *M'Coy.* P. F. 216.
elegantula, *Dalm.* P. F. 216.
fallax, *Salt.* S. F. 72.
flabellulum, *Sow.* Sil. 209.
hybrida, *Sow.* S. S. 630.
insularis, *Eichw.*
intercostata, *Portl.* G. R. 454.
interplicata, *M'Coy.* S. F. 31.
lata, *Sow.* S. S. 640.
occidentalis, *Hall.* P. N. Y. 1. p. 127.
parva, *Pander, sp.* Russ. Ur. 188.
Orthis porcata, *M'Coy.* S. F. 32.
productoides, *M'Coy.* S. F. 32.
protensa, *Sow.* S. S. 638.
radians, *Sow.* S. S. 639.
remota, *Salt.* Sil. 53.
retrorsistriata, *M'Coy.* P. F. 224.
reversa, *Salt.* S. F. 72.
rustica, *Sow.* S. S. 624.
sagittifera, *M'Coy.* P. F. 227.
sarmentosa, *M'Coy.* S. F. 34.
semicircularis, *Sow.* S. S. 639.
simplex, *M'Coy.* S. F. 34.
striatula, *Emmons.* Sil. 55.
sublævis, *M'Coy.* S. F. 35.
testudinaria, *Dalm.* Sil. 75.
triangularis, *Sow.* S. S. 640.
turgida, *M'Coy.* P. F. 229.
undata, *M'Coy.* P. F. 234.
unguis, *Sow. sp.* S. S. 640.
vespertilio, *Salt.* Sil. 74.
Orthisina ascendens, *Pand.* R. U. 203.
Scotica, *M'Coy.* P. F. 232.
Porambonites intercedens, *Pand.*
Rhynchonella *sp.* (lacunosa, *Portl.*)
depressa, *Sow. sp.* S. S. 629.
rotunda, *Sow. sp.* S. S. 629.
subundata, *M'Coy. sp.*
upsilon, *Barr.* P. F. 207.
Siphonotreta micula, *M'Coy.* P. F. 188.
Strophomena alternata, *Conr.* P. N. Y. 102.
antiquata, *Sow. sp.* S. S. 630.
applanata, *Salt.* M. G. S. 2. p. 380.
bipartita, *Salt.*
cancellata, *Portl. sp.* G. R. 450.
complanata, *Sow. sp.* S. S. 636.
concentrica, *Portl. sp.* G. R. 452.
corrugata, *Portl. sp.* G. R. 450.
deltoidea, *Conr. sp.* P. N. Y. 1. p. 106.
depressa, *Dalm.* S. S. 623.
expansa, *Sow.* Sil. 719.
grandis, *Sow sp.* Sil. 74.
pecten, *Linn. sp.* M. G. S. 2. p. 381.
plicotis, *M'Coy sp.* S. F. 25.
rugifera, *Portl. sp.* G. R. 453.
simulans, *M'Coy.* P. F. 246.
? spiriferoides. *M'Coy.* P. F. 246.
tenuistriata, *Sow.* Sil. 74.
Trematis punctata, *Sow. sp.* S. S. 610.

Lamellibranchiata (Monomyaria).

Ambonychia gryphus, *Portl. sp.* G. R. 567.
transversa, *Portl. sp.* G. R. 423.
trigona, *Münst.* G. R. 422.
Triton, *Salt.*
undata, *Hall.* P. N. Y. 1. p. 165.
? contorta, *Portl. sp.* G. R. 126.
Avicula bullata, *M'Coy.* S. F. 23.
posidoniæformis, *M'Coy sp.* S. F. 22.
Avicula ? vetusta, *Portl sp.* G. R. 442.
Pterinea fimbriata, *M'Coy* S. F. 21.
megaloba, *M'Coy.* P. F. 261.
orbicularis, *M'Coy.* S. F. 21.
panopæaformis, *M'Coy.* S. F. 22.
pleuroptera, *Conr.* P. F. 261.
sublævis, *M'Coy.* S. F. 23.
tenuistriata, *M'Coy.* P. F. 263.

Lamellibranchiata (Dimyaria).

Arcidæ.

Arca Apjohni, *Portl. sp.* G. R. 429.
dissimilis, *Portl.* G. R. 428.
quadrata, *M'Coy.* S. F. 20.
regularis, *Portl.* G. R. 427.
transversa, *Portl.* G. R. 428.

Nuculidæ.

Cucullella (*Clidophorus*) Anglica, *Salt.* Sil. 50.
Nucula (*Ctenodonta*) (*Tellinomya*)
grandæva, *Goldf.* Petr. 150.
lævis, *Sow.* S. S. 635.
Protei, *Münst.* Beitr. 3. p. 54.
radiata, *Portl.* G. R. 430.
subacuta, *M'Coy.* S. F. 19.
subæqualis, *M'Coy.*
subcylindrica, *M'Coy.* S. F. 19.
obliqua, *Portl. sp.* Sil. 213.
varicosa, *Salt.* Sil. 213.

Cardiadæ ?

Cardiola semirugata, *Portl. sp.* G. R. 430.
interrupta, *Brod.* S. S. 617.
Conocardium dipterum, *Salt.* Sil. 213.

Trigoniadæ ?

Lyrodesma plana, *Conr.* P. F. 272.
? Megalomus, *spec.* Sil. 214.

Mytilidæ.

Modiola Bryceæ, *Portl.* G. R. 425.
Nerei, *Portl.* G. R. 424.
securiformis, *Portl.* G. R. 425.
Modiolopsis expansa, *Portl.* Sil. 213.
inflata, *M'Coy.* P. F. 266.
modiolaris, *Conr.* Sil. 213.
obliqua, *Sow.* S. S. 635.
orbicularis, *Sow. sp.* S. S. 635.
postlineata, *M'Coy.* Sil. 213.
Mytilus cinctus, *Portl.* G. R. 426.
mytilimeris, *Conr.* M. G. S. 2. p. 364.
Orthonota nasuta, *Conr. sp.* P. N. Y. 296.

Gasteropoda.

Euomphalus Corndensis, *Sow.* S. S. 641.
lyratus, *M'Coy.* P. F. 298.
tenuistriatus, *Sow.* S. S. 641.
tricinctus, *M'Coy.* P. F. 299.
triporcatus, *M'Coy.* P. F. 299.
Holopea concinna, *M'Coy.* S. F. 12.
striatella, *Sow. sp.* S. S. 642.
Holopella monilis, *M'Coy.* S. F.
tenuicincta, *M'Coy.* P. F. 304.
Maclurea Logani, *Salt.* G. J. 176.
macromphala, *M'Coy.* P. F. 300.
Peachii, *Salt* Sil. 217.
Murchisonia angustata, *Hall,* P. N. Y. 1. p. 41.
bicincta, *M'Coy.* S. F. 16.
gyrogonia, *M'Coy.* P. F. 293.
obscura, *Portl. sp.* G. R. 415.
pulchra, *M'Coy.* P. F. 294.
simplex, *M'Coy.* P. F. 294.
Murchisonia subretundata, *Portl. sp.* G. R. 414.
sulcata, *M'Coy.* P. F. 532.
Ophileta compacta, *Salt.* Sil. 217.
Patella Saturni, *Portl.* (*Discina*), G. R. 416.
Pleurotomaria inflata, *M'Coy.* S. F. 15.
latifasciata, *M'Coy.* S. F. 15.
trochiformis, *Portl.* G. R. 414.
turrita, *Portl.* G. R. 413
Pryceæ, *Sow. sp.* S. S. p. 624.
Raphistoma lenticularis, *Sow. sp.* S. S. 642.
qualteriata, *Salt. sp.* M. G. J. 2. 256.
Ribieria ? complanata, *Salt.* Sil. 50.
Trochus constrictus, *M'Coy.* P. F. 296.
ellipticus, *His* Leth. 35.
Moorei, *M'Coy.* P. F. 297.
Turbo crebristria, *M'Coy.* P. F. 295.
sulcifer, *Eichw.* Russl. 53.
rupestris, *Eichw.* Russl. 54.

Heteropoda.

Bellerophon acutus, *Sow.* S. S. 643.
alatus, *Portl.* G. R. 471.
bilobatus, *Sow.* S. S. 643.
carinatus, *Sow.* S. S. 604.
dilatatus, *Sow.* S. S. 627.
Bellerophon nodosus, *Salt.* G. J. 10. p. 73.
subdecussatus, *M'Coy.* P. F. 311.
sulcatinus, *Emmons.* G. J. 10. p. 74.
perturbatus, *Sow. sp.* S. S. 641.
(*Euom. furcatus, M'Coy*)

PTEROPODA.

Conularia elongata, *Portl.* G. R. 393.
Sowerbii, *Defr.* M. C. t. 260.
Ecculiomphalus Bucklandi, *Portl.* G. R. 411.
Scoticus, *M'Coy.* P. F. 301.
Pterotheca corrugata, *Salt.*
Pterotheca transversa, *Portl.* Sil. 218.
Theca simplex, *Salt.*
reversa, *Salt.* Sil. 218.
triangularis, *Portl.* Sil. 218.
vaginula, *Salt.*

CEPHALOPODA.

Cyrtoceras inæquiseptum, *Portl. sp.* G. R. 382.
multicameratum, *Hall.* N. Y. t. 42.
Lituites anguiformis, *Salt.* P. F. 323.
cornu-arietis, *Sow.* S. S. 643
Hibernicus, *Salt.* Sil. 220.
planorbiformis, *Conr.*
Sowerbyanus, *d'Orb.* Prod. p. 1.
Oncoceras, *sp.* Siluria, p. 217.
Orthoceras arcuoliratum, *Hall.* P. N. Y. t. 47.
angulatum, *Wahl.* Leth. 28.
(*O. virgatum. Sil. Syst.*)
annulatum. *Sow.* M. C. t. 133.
Avelinii, *Salt.* Sil. 50.
bilineatum, *Hall.* P. N. Y. t. 43.
breviconicum, *Portl.* G. R. 373.
Brongniartii, *Troost.* Sil. 219.
calamiteum, *Münst.* Beit. 1. p. 36.
centrale, *His.* Leth. 29.
complanatoseptum, *Portl.* G. R. 374.
Orthoceras elongato-cinctum, *Portl.* G. R. 372.
encrinale, *Salter.* Sil. 50.
filosum, *Sow.* S. S. 620.
ibex, *Sow.* S. S. 613.
perannulatum, *Portl.* G. R. 367.
politum, *M'Coy.* P. F. 316.
Pomeroense, *Portl.* G. R. 370.
primævum, *Forbes sp.* G. J. 1. p. 146
subannulatum, *Münst.* B. 3. p. 99.
subarcuatum, *Portl.* G. R. 374.
subgregarium, *M'Coy.* S. F. 9.
subundulatum, *Portl.* G. R. 373.
tenuicinctum, *Portl.* G. R. 371.
tenuistriatum, *Münst.* Beit. 3. p. 102.
vagans, *Salt.* Sil. 219.
vaginatum, *Schlot.* G. J. 7. p. 177.
Phragmoceras approximatum, *M'Coy.*
Brateri, *Portl.* G. R. 383.
subfusiforme, *Portl. sp.* G. R. 381.
subpyriforme, *Portl.* G. R. 381.

Localities of Lingula-flag-stones :—Tremadoc, Dolgelly, Penmorfa, Maentwrog, Ffestiniog, N. Wales; Whitesand Bay, S. Wales.

Characteristic Fossils :—Lingula Davisii, Olenus micrurus, O. humilis, Hymenocaris vermicauda, Agnostus pisiformis.

Localities of Llandeilo Rocks : —Llandeilo, Builth, Llanrhaiadr, Berwyns, N. Wales; Abereiddy Bay, Musclewick Bay, S. Wales; Mytton Dingle, Bogmine, Shelve district, Shropshire.

Characteristic Fossils.—Didymograpsus Murchisonii, D. geminus, Diplograpsus pristis, D. teretiusculus, Graptolithus lobiferus, G. tenuis, G. Sedgwickii, Orthis alata, O. striatula, Lingula Ramsayi, L. granulata, Trinucleus Murchisonii, T. fimbriatus, Ogygia Buchii, O. Selwynii, Asaphus tyrannus Calymene brevicapitata, C. duplicata, C. parvifrons, Æglina binodosa, Agnostus Maccoyii.

Localities of Caradoc Rocks :—Caradoc Hills, Horderley, Hoar Edge, Sondley, Chatwall, Cheney Longville, Bala, Tyrone, Wexford.

Characteristic Fossils. Zoophyta :—Stenopora fibrosa, Nebulipora lens, Diplograpsus pristis. *Echinodermata :* —Glyptocrinus basalis, Echinosphærites punctatus, Caryocystites munitus, C. pyriformis, Palæaster obtusus.

Trilobita —Homalonotus bisulcatus, Asaphus Powisii, Trinucleus, concentricus, T. seticornis, Phacops apiculatus, T. conophthalmus, Calymene brevicapitata.

Brachiopoda.—Leptæna sericea, Orthis Vespertilio, O. calligramma, O. flabellulum O. Actoniæ, Orbicula punctata, Strophomena expansa, S. tenuistriata.

Lamellibranchiata :—Nucula varicosa, Modiolopsis modiolaris, M. orbicularis, Orthonota nasuta.

Gasteropoda :—Murchisonia simplex, Turbo crebristria.

Heteropoda .—Holopea concinna, H. striatella, Bellerophon acutus, B. bilobatus.

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(*To be continued.*)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Origin of the mud in these volcanos—Rarity of Sulphate of Potash in nature—Abundance of sulphate of soda—Beds of this salt in Spain.

We have stated that the mud discharged in these eruptions derives its origin from the materials of the mountains themselves. It replaces the lava of ordinary volcanos, as we observe to be the case with other mud-erupting craters which emit little or no lava—for instance, those of South America. We also observe that vitreous volcanic formations, such as obsidian, pearl-stone, pumice, &c., are entirely wanting in some volcanos, where compact or porous lava is the common product. Volcanic productions are, indeed, extremely variable, and differ according to the particular volcano to which they owe their birth. Humboldt informs us that the mineral composition of lava differs according to the nature of the crystalline rock of which the volcano is formed, the height of the point where the eruption occurs, and the temperature of the interior of the mountain. If we consider the marvellous production of minerals by the sole influence of water heated to 400° Centigrade, as related in one of our former papers—if we consider that steam (which in volcanos is frequently acid) may be heated to an enormous extent—we shall readily conceive the production of some varieties of lava by the agency of hot water, acid vapour, and gases, and that of the mud in the Javanese and South American volcanos. Let us add, in conclusion, that the eruptions of mud-volcanos are accompanied or preceded, as in lava-producing mountains, by earthquakes, subterranean thunder, smoke, cinders, &c.

Sulphate of potash, as a mineral species, is extremely rare; it is known to the French mineralogists as Aphthalose; in Italy it goes under the name of *Aftalosio*, and is occasionally found in small white crystals on the lava of Vesuvius, or as a dry powder in the cavities of the lava. Some time ago Signori Corvelli and Monticelli remarked that the Aftalosio of Vesuvius is generally very impure, being frequently mixed with salts of copper or iron, but principally with common salt (chlorides of sodium). Signor Barresi, who is at present attached to the faculty of natural history in the University of Palermo, has just discovered, in Sicily, the mineral species of which we speak, in beautifully regular crystals, and perfectly pure. The samples he has collected are looked upon by naturalists with deep curiosity, and the learned professor has written upon his discovery a long paper, which we have not yet had the good fortune to receive.

If sulphate of potash be excessively rare in nature, the same cannot be said of sulphate of soda, which salt, though quite as soluble in water as the former, exists in enormous quantities near Lodosa, in Spain. Lodosa is a dirty little town on the confines of Navarre, and the province of Old Castille. The salt is also met with in the mountains of San Adrian and Alcanadre. M. de Lajonkaire has lately made extensive investigations concerning these important deposits.* The following is, for the two mountains just named, the general disposition of the strata where the sulphate of soda exists:—

1, Vegetable earth; 2, six to twelve feet of alluvial sand and clay, almost white; 3, a bed, seventy feet thick, of rolled stones, which are sometimes firmly cemented together by an argillaceous limestone; 4, about 165 feet of a green argillaceous marl, with beds of crystallized gypsum; 5, twelve to fourteen feet of wine-coloured gypsum in marl of a like colour; 6, seventy-five feet of fine-grained variegated sandstone; 7, a bed of sulphate of soda, from a few inches to eight or nine feet thick; 8, seventy feet of blue schistose marl, with veins of gypsum; 9, another bed of sulphate of soda, varying in thickness from a few inches to forty or fifty feet; 10, about seventy-five feet of blue clay and gypsum; 11, thirty to forty feet of a fine-grained argillaceous sandstone, red and green; 12, a thin layer of common sea-salt mixed with clay; 13, fifty feet of green and red sandy marls; 14, twenty-five to one hundred feet of a red argillaceous sandstone alternating with pudding-stones of a similar colour.

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* They are far less important now, however, than formerly. The artificial sulphate of soda manufactured in large quantities from common salt for the use of the glass makers, the artificial production of carbonate of soda, &c., have greatly diminished in value the natural deposits.--T. L. P.

These strata, which are frequently dislocated, uplifted, irregular, and partially destroyed by water, furnish us with a tolerable idea of a triassic formation.

Brussels Tertiary and Fossils—Grœnendael—Laeken—Fossil palm-nuts and wood, pierced by the Teredo—Fossils having the odour of the Primeval Seas—Italian Earthquakes—Singular relation existing between magnetic observations and Earthquakes—Startling hypothesis proposed to explain Geological phenomena—Terrestrial magnetism—Earthquakes again—Novel production of artificial Coal and Anthracite.

During the five or six years I was occupied in scientific pursuits at the University of Brussels, I employed various means to make the acquaintance of, and to be on good terms with, the workmen employed in clearing away the sandy strata which surrounds the town; and especially with those occupied in levelling a great part of the *Faubourg de Schaerbeek* Brussels, like Rome, is built upon seven hills, so that the works of which I speak often attained a considerable depth, affording many an opportunity of noting the exact disposition of the strata and the fossils they contain. By sundry promises of *faro* and cigars, I prevailed upon several workmen to bring to me everything "curious-looking" that they happened to meet with in their work of excavation, or to send for me immediately if the treasures they dug up were too large or too heavy to be transported to my abode.

In this manner I got hold of a good deal of rubbish, such as curiously shaped stones, clotted sand, differently coloured flints, &c.; but I soon found myself in possession of some very rare and curious specimens, which even the Professors of the University looked upon with wonder, and which have more than once excited the curiosity and admiration of the illustrious and much regretted Dumont, who sometimes honoured me with a visit.

Brussels, I should also inform my readers, stands upon the lower or more ancient of the tertiary strata. D'Omalius d'Halloy classes its strata in the *middle Eocene* formation; the town and its environs are built upon an immense bed of sand, often calcareous, and presenting frequently blocks of calcareous sandstone, which gradually blend into a sort of shining quartzite, known as *grès luisant* by the Belgian and French geologists, and blocks or strata of white or yellowish limestone. These are all employed, to a certain extent, for building and paving, but the stones they furnish are not large enough to be very valuable. This deposit is tolerably rich in fossils, most of which are also found in the lower strata of the Paris tertiaries, which are of the same age.*

At Grœnendael—a lovely spot to the south of Brussels, a small village,

> "Where greenwoods, lakes, and fragrant flowers,
> Mossy banks and sweet-scented bowers,
> Chase from our thoughts toil, care, and strife,
> Recal bright summer-days of life,"

and which affords a far better harvest to the botanist than to the "brother of the hammer"—the sand and blocks of sandstone are impregnated with a great quantity of yellow oxide of iron (*limonite*), which, when found in crystalline blocks of a darker colour, is extracted for working, as it forms a tolerable iron-ore. At Laeken, the favourite residence of king Leopold, we have another and more recent stratum of sand, belonging, perhaps, to the *upper Eocene;* but geologists are divided in opinion as regards its relative age.

Among other fossils brought to me from the middle Eocene sand of Schaerbeek were some magnificent specimens of a sort of cocoa-nut.† Once upon a time these "cocoa-nuts" (*Nipadites*) grew and flourished at Brussels; now-a-days it is as much as we can do to keep the hardy date-palm alive in this climate. In the same strata with the "cocoa-nuts" (which are always completely petrified, are found petrified stems of palm-trees, bamboos, and poplar-trees.

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* Our readers should refer to Sir C. Lyell's "Memoir on the Tertiary Formations of Belgium," in the Journ. Geol. Soc., vol viii, for details of the structure and paleontology of that country, and for references to other authors and geologists who have treated of the same subject.—Ed. Geologist.

† See Lyell's Memoirs, *op cit.* p. 344 and pl. 19, for an account and figures of these palm-nuts, allied to those of the *Nipa*.—Ed. Geologist.

These palm-nuts, bamboos, and poplar-like trees are sometimes found pierced in all directions by a species of *Teredo*, which has left its worm-shaped shells in the petrified wood. Sometimes large clusters of the calcareous tubes of this mollusc are found covering, or buried in, the stem of a poplar or palm-tree; sometimes again they show themselves in compact masses, where only a slight vestige of a tree-stem remains discernable; in this case the wood has been so thoroughly tunnelled, that hardly any of it remains.

The fossil* of which I speak belongs to that tribe of worm-shaped mollusca so much dreaded by shipowners before the copper-sheathing of vessels was imagined. The animals of this genus lay their eggs upon the surface of submerged wood; the young *Teredo*, as soon as it is excluded, begins to work its way inward, and continues to proceed to a greater depth as it grows larger. Its mode of operating, both curious and wonderful, is described in works on Zoology; its tunnelling apparatus exceeds everything man's genius has yet brought to bear in making *his* tunnels. The particular species to which I allude as being found in the fossil-trees of the Schaerbeek sand, is the *Teredo corniformis* of Lamack.† The existing Teredo makes the same havoc amongst the cocoa-nuts and palm-stems which float at the present time in the tropical seas, that its predecessors made thousands of centuries ago, when flourishing amidst the waters that deposited the middle Eocene beds of Brussels.

Our readers have doubtlessly heard of the marvellous property possessed by musk of retaining its odour for a long period of time—months, nay, years, may clapse, and the musk is as odoriferous as ever. But can any odour be retained for 100,000 years or more? My fossil Teredos answer this question in the affirmative! When these fossils are fresh from the strata in which they lie, they have a strong smell of the sea; so strong, indeed, in some specimens that I could hardly believe it possible. The odour of the sea is, however, very characteristic, and not easily mistaken or forgotten; it has been remarked in very early historical periods. If I remember rightly, Quintius Curtius Rufus, in one of the ten books which he wrote to convey to posterity the "History of the Reign of Alexander the Great," says that the pilots recognised the sea by its odour, "agnoscere se auram maris." However, to assure myself that the odour of the tertiary sea was not an illusion, I immediately had the fact certified by a considerable number of persons, among whom I could name some very eminent and popular men. All, without exception, were delighted at the idea of their olfactory organs thus launching them into the byegone ages of geological periods, and marvelled at the prodigious number of years the fossils I have described had retained their smell. I then made known this discovery to the Paris Academy of Sciences.

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* See Forbes' and Hanley's "British Molluscs" for a good account of the Teredo.—Ed. Geologist.

† In the Province of Brabant, we have two or three other fossil species of the same genus.—T.L.P.

I have said that the fossils here alluded to were taken from the *middle Eocene* of Brussels; they have, therefore, retained their odour for thousands of centuries!

M. Prost, who inhabits Nice, has furnished us with many observations on the earthquakes of Italy, and on the oscillation of the ground along the coasts of the Mediterranean. Very frequent, and even violent, in the year 1855, these terrible commotions became milder in 1856; but took a new degree of intensity in the year 1857, when, on the 20th and 21st of August, a strong shock was felt on the Italian and African coasts. Here are, however, some curious observations recently communicated to the Academy of Sciences at Brussels by the learned Secretary, M. Quetelet, Director of the Brussels Observatory, and which tend to show that there exists a certain relation between the magnetic forces of our planet and the phenomena of earthquakes. "In the forenoon of the 17th of last December," says M. Quetelet, "a violent magnetic perturbation was observed by my son in the Brussels Observatory." At noon the perturbation increased considerably; the proximity of an Aurora borealis was presumed to be the cause of this phenomenon, and shortly afterwards the local papers spoke of the apparition of an Aurora borealis, which had been seen at Brussels between five and six o'clock on the morning of the 17th. The customs-officers stationed at the gates *Porte Joseph II.* and *Porte de la Loi*, near the Rue Montoyer, were the first to remark it; they thought it was the effect of a tremendous fire in some part of the town. The luminosity spread from north to south across the heavens, preserving its brilliancy throughout, and detaching itself gloriously from a background of cloudless sky glittering with stars.

It was learnt shortly afterwards that a most violent earthquake had ravaged, on the night which separated the 16th and 17th of December, the greater portion of the two Sicilies, especially the town of Salerno, Potenza, and Pola. Many thousands of the population perished in the Basilicata and neighbouring provinces, where the phenomena appear to have been concentrated. Naples itself experienced three violent shocks, which, however, were fortunately unattended by loss of life. Other convulsive movements of the earth were felt in Naples on the 19th, 20th, and 23rd of the same month. The inhabitants, much terrified, hoped and prayed for an eruption of Vesuvius. The earthquake of the 17th December produced a certain effect on the south parts of Germany. Bavaria and Wurtemburg likewise experienced its influence; and on the 20th December, at half-past five o'clock in the morning, violent shocks were felt at Agram, in Crotia. The undulations of the ground took a direction from the south-east to the north-west, and the shaking of the earth lasted about three hours and a half.

During the early days of last January, the amplitude of oscillation in the magnetic needle of the Brussels Observatory evinced considerable irregularity, especially on the 5th, 6th, and 7th of that month. But on the 9th the needle was, moreover, suddenly displaced at each oscillation. The papers made known shortly afterwards that an earthquake had taken place on the 8th and 9th of January, at Varna.

These data evidently tend to prove that a certain relation exists between the phenomenon of earthquakes and terrestrial magnetism.* But this relation of which we speak, to what extent is it established? Can we admit, with Mr. Evan Hopkins, that terrestrial magnetism is the great and sole agent of nature by which all geological changes have been, or are, accomplished? Certainly not. This author's hypothesis is, however, extremely curious. We are indebted for an abstract of it to an accomplished geologist, Miss Catherine J. B. Taylor, and we are thus enabled to let our readers judge for themselves. Mr. E. Hopkins endeavours to demonstrate that "the slow operation of that power which we call terrestrial magnetism accounts for all the changes observed on the surface of the earth, in the structure, combinations, and relations of the crystalline and sedimentary rocks, individually and collectively." This is certainly somewhat startling. "Mr. E. Hopkins endeavours to prove his theorem," says a writer of the present day, "by the general principles of the polarity of matter, the ascertained meridional structure of the crystalline rocks, the distribution of metalliferous deposits, &c. . . The fact of the general meridional structure of crystalline rocks is pretty clearly established; and Mr. Hopkins adds, from his own observations, additional proofs of the extent to which this formation prevails over the surface of the globe."

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* Whilst writing the above, the following passage of Humbolt's is irresistibly called to mind:—"When the needle, by a sudden disturbance in its horary course, indicates the presence of a magnetic storm, we are still unfortunately ignorant whether the seat of the disturbing cause is to be sought in the earth itself or in the upper regions of the atmosphere." (*Cosmos, vol. I.*)—T.L.P.

But the most surprising part of the hypothesis is that in which it is affirmed that the solid parts of the earth's surface are, by the same influence (terrestrial magnetism), perpetually, though slowly, moving from the south to the north, this being represented as affording the only solution to certain obscure problems which have long puzzled geologists and astronomers. The rate of the meridional progression is estimated as high as one minute (one-sixtieth of a degree) in three years, or one degree in 180 years; so that in 2,700 years the northern parts of Australia will be right under "the line," and in 3,600 years the Orkney and Shetland Isles will be nearly on a level with the north pole! "Supposing this rate of movement to be constant," says the writer quoted above, "the spot on which London stands must have been in the equator some 9,180 years ago, and the whole of England will be within the arctic circle in about 2,800 years hence. Thus may be explained the phenomena of organic remains of plants, which must have lived and died on the spot where they are found, though the climate now around them is utterly unfit for their existence. Thus also may be explained the position of the stars since the altered period of the earliest authentic records of astronomy. Instead of the *precession of the equinoxes*, or the bodily oscillation of the globe, Mr. E. Hopkins maintains that a slow but steady movement of the crystalline surface of the earth, from pole to pole, would account for all the phenomena."

Where will imagination carry us—or, rather, future generations, when they find themselves all safely lodged at the north pole? Magnetism, after all, is but one of the many physical forces which have acted, and still continue to act, upon our globe; and why should *that one* be regarded as the origin of all the others, any more than heat, electricity, or motion?* Mr. E. Hopkins must answer this question before his hypothesis can be submitted to serious consideration.

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* Consult on this question, Grove's "*Correlation of Physical Forces.*"—Ed. Geol.

And now to return to the fearful Italian earthquakes. The volcanic disturbances in Naples do not appear to have entirely ceased. At Montemurro three shocks were felt immediately before dawn on the 26th of February; and afterwards, about daybreak, so violent an earthquake took place, that the inhabitants fled, with cries and tears, from their beds into the open country, and were still more alarmed when they learnt from some peasants that the ground had been seen to open and close again at each shock.

At the same time, a severe commotion was experienced in Viggiano, where some walls fell, without doing further injury. Belvano, also, on the 23rd, was shaken, but rather less severely; and, on the same day, towards night, the inhabitants of Saponara heard, at an interval of thirty seconds, two subterraneous noises, resembling the reports of a very large piece of cannon. At the trembling of the ground, the terrified inhabitants fled from their houses, and gathered together for prayers in a chapel. Other slight shocks have since been felt in many places of the Basilicata, not excepting Potenza, so fearfully shaken by the former commotions. We cannot resist noting down here two striking features of the human character, which the late earthquakes in Italy have enabled certain persons to observe. In spite of the apparent violence of the phenomenon in Naples, and the utter ignorance that prevailed as to what might be the dreadful and immediate consequences, bands of thieves entered the houses deserted by the frightened tenants, and ran off with everything they could lay their hands upon. Indeed, some of the Italian papers assure us, that greater loss was sustained in Naples by these robberies than by the earthquake itself. Does not this fact tempt us to exclaim, "Man's greatest enemy is man?" But the same papers report (and we notice it with pride and pleasure), that the promptest and most generous succour proffered to the unfortunate sufferers from the earthquake and its effects, came from the English residents at Naples, who immediately subscribed large sums of money, to be distributed among their distressed fellow-creatures.

We will now call attention to an ingenious method by which coal has lately been produced artificially, and, as far as we know, for the first time. The experiment to which we are about to refer formed the subject of a recent communication to the Academy of Sciences at Paris, on the part of the author, M. Barouilier, who has accomplished the mineralogical feat in question by means of an apparatus, extremely simple, that enables him to submit vegetable matters previously enveloped in damp clay, to an elevation of temperature ranging between 200 and 300 degrees Centigrade, and sustained for a long period of time. The apparatus is not perfectly or hermetically closed, but allows, though with difficulty, the vapour and the different gases to escape. In this manner, organised vegetable tissues are decomposed at a moderate temperature, and under a sufficient degree of pressure to prevent any serious disagregation of their parts. Saw-dust of different kinds of wood produces, in this experiment, *different varieties of coal;* and, moreover, stems and leaves print their forms on the clay in a thin bituminous, or coaly layer, which gives to the specimens produced the aspect of every description of coal-schist on which we observe, in nature, similar impressions.

We must here remark, however, that, long before the time of M. Barouilier, Hutton used, with many others, to look upon coal as the product of a species of dry distillation; and, to give to his ideas all necessary confirmation respecting this, he submitted pieces of wood to intense calcination in a hermetically closed iron vessel. He obtained in this manner a species of coal, or rather a melted mass of something very much resembling coal, but which showed no organic texture whatever. But, from the beautiful investigations of MM. Link, Ehrenberg, and many microscopists, it is next to impossible to find a piece of coal which does not evince ample proofs of its organic origin by the numerous, and oftentimes perfectly preserved, organised tissues it contains. The most important feature in M. Barouilier's experiment is, then, the production of coal, preserving, at the same time, its organic texture entire. Other experimental philosophers, amongst whom we should name Hutton, Petzholdt, Cagniard de la Tour, &c., have produced curious varieties of *carbon* or *bitumen*, in their experiments—M. Barouilier has formed *coal.**

(*To be continued.*)

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* In the second volume of the new edition of Mantell's "Wonders of Geology," just published, our readers will find an ample *résumé* of microscopical researches in the structure of coal, and a notice of the experiments by Goeppert and others, in illustration of the nature of coal.—Ed. Geologist.

ON AN ERRONEOUS STATEMENT OF THE OCCURRENCE OF NATURAL HUMAN FOOTPRINTS IN THE PALÆOZOIC ROCKS.

To the Editor of the GEOLOGIST.

MY DEAR SIR,

In 1822[*] Mr. Schoolcraft figured and described a block of limestone, bearing two prints of human feet, from the western bank of the Mississippi at St. Louis, and wrote regarding them thus: "These impressions were made at a time when the rock was soft enough to receive them by pressure, and the marks of the feet are natural and genuine." He added, however, that Col. Benton considered them to have been "the result of human labour," and probably belonging to the same period as that when the mounds in the neighbourhood of St. Louis were raised. I may add, from Dr. D D. Owen's statement, that Messrs. Maclure, Say, Troost, and Lesueur agreed as to the artificial origin of the prints.

The late Dr. Mantell introduced into some editions of his "Wonders of Geology" an account of these footprints; illustrating them with a woodcut,—accepting the hypothesis of their having been naturally produced,—and erroneously terming the rock "sandstone."

In 1842[†] Dr. David Dale Owen, having obtained possession of this slab of stone, and being desirous of explaining its true character, carefully examined it, and found that it contained fossils of the mountain-limestone age, and that "the impressions in question are not fossils, but an intaglio, of artificial origin." Dr. Owen also freely, and with justice, criticised Dr. Mantell's remarks on the specimen; and he referred to Leonhard's cautious notice of the same slab.

In the sixth edition of the "Wonders," [‡] in 1848, Dr. Mantell intimated that he no longer used these sculptured footprints as evidence of the early existence of man on the earth, since Dr. D. D. Owen had proved them to be artificial.

In a little book entitled "Voices from the Rocks, "lately published, I have seen, to my surprise, a woodcut of these footprints, which, copied from the suppressed illustration once used by Dr. Mantell, is unscrupulously brought forward as an established evidence of the geological antiquity of man.

Now, Mr. Editor, what is to be thought of any one, writing on geology at the present day, and pretending to settle a philosophical question by reference to facts, who produces as geological evidence a well-known misconception, which had actually been ignored by the very author from one of the older editions of whose work this second-hand writer, without the least examination or research, borrows it as the basis for his chief argument in support of the untenable hypothesis of the existence of man in the palæozoic period?

For my part, being interested in the scientific reputation of my late friend, Dr. Mantell, and in that of his works, some of which I have had the pleasure of editing, I beg permission to express in your journal, which, I trust, has the wide circulation it deserves, my sincere regret that any one could be found to exhibit such a carelessness of truth, or ignorance of fact, in a book intended for an intelligent public.

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[*] American Journal of Science, vol. v., p. 223, &c.

[†] American Journal of Science, vol. xliii., p. 14, &c.

[‡] Vol. ii., p. 90, *note.*

I am, dear Sir, yours, &c.,

Somerset House, April 10, 1858. T. Rupert Jones.

NOTES AND QUERIES.

Bone-bearing Gravel of Cropthorne.—New Fern from the Coal near Bewdley.—Passage-bed between Silurian and Devonian Rocks in the Abberley Hills.

(*Extract of a letter from* Mr. G. E. Roberts *to the Editor.*)

Dear Sir,—I have made two or three minor discoveries this month, but not of importance to warrant a paper; however, they are *interesting*, so you may use them as you please as extracts from this letter.

The bone-bearing gravel of Cropthorne (near Evesham), a post-tertiary deposit, is well known for its bones of Pachydermatous and other mammalia. I have discovered a northerly continuation of this at Himbleton (four miles north-east of Worcester). It there forms a terrace-line on the lower Lias, and presents the usual lacustrine indications; shells of *Unio*, *Lymnæa*, and *Cyclas* occurring among the gravel and bones, as in the Defford and Cropthorne beds. I have met with no elephantine remains, however; the bones (vertebræ, tibia, &c.) being restricted to one *Bos* (*B. longifrons*) and a *Cervus*. I first noted this ossiferous gravel in September last, and, meeting Dr. Falconer soon after, brought some of the bones under his notice. The bed is there six feet in thickness, and also contains bones of Saurians (*Ichthyosaurus tenuirostris* and *I. intermedius*) washed out of the Lias shales upon which it rests.

The hollow bones (tibia, &c.) are filled with an infiltration of marl, and are pierced, in some instances, by *Teredines* (?)

I have lately been working at a bed of estuarine shales, belonging to the upper Coal Measures, and exposed on the east bank of the Severn, two miles north of Bewdley. A new fern, of great beauty, from thence, is in the hands of Professor Morris, who intends to describe it. I have, also, from this bed, several fine fronds of *Pecopteris*, attached to the rachis, which fact goes far, I think, to connect these plants in a direct line of ancestry with our living *Pteris* and *Lastræa*; I had rather believe them such than the mere leaves of Sigillarian trees, as some have thought. The rachis is, in its compressed state, from half to three-quarters of an inch in width, just the dimensions of a recent fern-stalk, grown succulent in a damp situation.

My last excursion was to the north end of the Abberley Hill. Here I can add some trifling matter to Professor Phillips's admirable monograph ("Palæozoic District of Malvern and Abberley," &c., &c.) I believe the equivalents of the Ludford Fish-bed, of the "Trochus and Beyrichiæ bed," and of the "Railway shales," are to be found there. The characteristic fossils of the first I have met with, but they are distributed through six feet of deposit, instead of being confined within the narrow limits of the "Fish-bed." (Shagreen-scales, a simple plate of *Cephalaspis*, fragments of fish-bone and *Onchus* spines.) Again, in the upper Ludlow Tilestones, well exposed on both sides of the terminal hill, *Trochus helicites* occurs, and *Beyrichiæ* (two or more species), but I cannot detect the true equivalent of the "Trochus and Beyrichiæ bed."

Orthis lunata is very abundant where the Fish-bed *ought* to be, and *Orbicula rugata*; so we have the leading fossils, if we are here beyond the confines of that remarkable conclusion of ichthyic life. However, I do not think we are.

The rarest fossil I met with was *Agnostus Maccoyii*, in the Downton Sandstones, on the west side of the hill. I was pleased to find, on the east side, in the same formation, the equivalent of the Downton Vegetable-bed. The fossils are little more than carbonaceous stains and nodules, such as are described in "Siluria," p. 139. These are, of course, much older in the annals of terrestrial vegetation than the well-defined vegetables of the upper Tilestones, first discovered by myself at Trimpley, two miles north-west of Kidderminster.

Interpretation of Gen. II. v. 5.—"Sir,—I observe in your last number (IV.) p. 160, a reference made by a correspondent, E. R. J. (Farnborough), to Gen. ii. 5, 'where it is written that no rain had fallen up to the carboniferous period.' As you have not rectified the quotation, according to the authorised version of the Bible, I begin to surmise that there may be a new translation, agreeable to modern discoveries, current and accepted by the geological world. If this be so, I should be glad to know where such translation or paraphrase of Scripture may be obtained, and the grounds on which the 'day' mentioned in the 5th verse is considered as the 'carboniferous period.' The 2nd verse indicates an immense evaporable surface from the very beginning." F. S. K. (Bromley).—We inserted E. R. J.'s letter as being a question on the subject of rain-drops, and we restricted the answer given to assigning to them their correct geological position; in doing which we necessarily not only ignored, but refuted, E. R. J.'s reading of the passage he referred to, and pointed to such an ancient extent of water as that to which F. S. K. alludes. E. R. J.'s interpretation of the 5th verse of Gen. ii. is his own, and not ours. We felt disinclined to take up the question in its religious aspect or bearings. Of course Geologists do not attempt to interpret the Bible; they have only made from time to time, in their endeavours to reconcile the proven facts of their science with the Mosaic record of the Creation, various suggestions for theologians to admit or reject, as being in harmony or discordance with the meaning and sense of the original words of the Biblical statement.

Geology of St. Ives.—"Sir,—Could you please to inform me (a beginner in geology) whether I can find fossils here, and what formation this town is upon or near. This would much oblige me." R. A. C., St Ives, Huntingdonshire.—St. Ives is situated on the Kimmeridge clay. To the east of that town are some of the Portland beds over-spread by "drift" deposits; to the west, the Oxford clay immediately succeeds the Kimmeridge clay; and the whole surrounding county is greatly covered by the Boulder clay, the valleys being occupied by deep accumulations of gravel. In the valley of the Ouse, at Hemingford Abbots, the Rev. Mr. De la Condamine discovered a fresh-water deposit, an account of which was read before the Geological Society in 1853. Fossils are to be found in all these deposits; those of the Kimmeridge and Oxford clays are abundant, and beautifully preserved. Mammalian remains are, at all times, likely to be met with in the gravels, and, as a good many extraneous fossils are commonly obtained from the Boulder drift in other localities, they are also likely to be met with in that deposit in the neighbourhood of St. Ives.

Nereites from the Irish Coal Formation.—"Dear Sir,—Can anybody inform me whether any Nereites (such as the *Nereites Cambrensis* of the Lower Silurian) have been found in the coal-measures at all—and if so, what is its name, and where is the description to be found? I have some idea of one being found, and described, from Ireland. I have a fine impression from the 'hard rock' between the coal measures, and should be glad to know if it is a unique fossil." G. P. Bevan, M. D., Beaufort.—The querist probably refers to Professor Harkness' description and figure of *Nereites carbonarius* from the Millstone grit of Clare, given in the Edinburgh New Philosophical Journal, 1855, Vol. I., p. 278.

Potato-stones.—"Sir,—It may be useful to such of your readers as are visiting this part of the country, to learn that the 'potato stones,' alluded to in your answer to E. A. W., are only found in a field at the foot of Sandford Hill, and not generally upon the Mendip range. A stranger will readily be directed to the place by enquiring for the 'potato-stone field.' Will you oblige by telling me the scientific name of these curious bodies? How are they supposed to have been formed? Are they known to have been found in any other part of England? No geologist ought to visit Somersetshire without having a view of the remarkable collection of fossil bones, the property of Mr. Beard, of Wint Hill, who is always pleased to show them to strangers. I am, &c., Frank Dymond (Weston-super-Mare)."—Will our correspondent furnish us with information as to the rock in which the "potato stones" he refers to are embedded, so as to enable us to explain the circumstances of the concretion of the silicеous and calcareous materials of those geodes probably in cavities in the rock.

Work on Petralogy.—"Sir,—In the last number of the 'Quarterly Journal of the Geological Society of London' there is an abstract of what seems to be a good German work, by Dr. Senft, on the *Classification and Description of Rocks*; and for this abstract we are apparently indebted to Professor Morris. Permit me, through your very useful periodical, to enquire whether Professor Morris, or any other of our English Geologists, intends to put that excellent work in an English dress. I believe I am far from being alone, when I say that there is no work so much needed among English Geologists, as a good one on Petralogy. So far as I am aware there is no separate English treatise on this subject, except the useful work of Dr. Macculloch, which, having been so long out of print, cannot now be obtained for love or money. May I, therefore, ask whether the above work, translated into English, or any other separate treatise on this subject, is known to be forthcoming, to fill up that blank in our geological literature, or whether there does already exist any good English work which may be unknown to me. I am, Sir, &c., J. Simpson. (Mary Kirk, by Montrose.)"—We cannot answer our correspondent's enquiry. We are quite aware of the necessity of some good work or translation of the kind referred to, but we do not know of the existence of any. A series of papers will shortly be commenced in this Journal on the mineralogical structure and conditions of rocks, which we hope will do much towards remedying this deficiency in our geological literature.

The Disproved Human Footprints.—"Sir,—I do not know whether your attention has been called to a little work lately published, entitled 'Voices from the Rocks,' in which the anonymous author deals very summarily with the conclusions of modern geologists. He produces proof of man's existence during the earlier deposits, and gives an engraving of human foot-prints in the old red sandstone. Is there any authentic account of such a discovery, and what is it? Can you enlighten your readers, and amongst the rest a subscriber?" E. G.—The fossil character of these so called human foot-prints was suspected at the time of their discovery, and their artificial origin has long been known. We have received the book for review; and beg to refer our correspondent to Mr. Rupert Jones's letter on this point, in the present number, where the whole history of this affair is detailed.

Geology of Aldershott.—"Dear Sir: Will you kindly inform me the nature of the strata of the district about Aldershott and Ash, and to what operation its peculiar conformation can be attributed, and oblige one of your readers?" J.H.B.—The Aldershott district has a foundation of London clay, which rises up against the chalk-hills of Guildford. At Ash begin the Bagshot sands, which extend northward to East Hampstead, and to the east and west for several miles. The lower Bagshot strata, about 130 feet thick, lying on the London clay, are seen at Woking, Sunning-hill, East Hampstead, &c. A band of about forty feet of green and clayey sands forming the Middle Bagshots, occur at Worplesdon, Goldsworthy-hill, Finchampstead, and Farnborough, and in these a few fossils were found at the cutting of the Southampton Railway at Goldsworthy-hill. The upper Bagshot sands, 150 feet thick, form the flat-topped ridges of Chobham, Aldershott, East Hampstead, Bagshot, and the Heaths, being capped with the Pleistocene gravels, which, combined with these sands, are the cause of the wild character of the scenery of those districts.

Preservation of Pyritous Fossils.—"Sir,—Taking advantage of your department of Notes and Queries, I shall be glad of information as to the best mode of preserving specimens containing pyrites. I have several, of some curiosity, which are daily decomposing." X. Y.—There is nothing so destructive to fossils as pyrites; and the wood of drawers in which such specimens have been kept becomes impregnated with the sulphuric acid generated in the decomposition, and are thus rendered unfit for future service, especially for chalk fossils. The pyritous fossils of the London clay are notoriously difficult to keep; the great thing seems to be the entire exclusion of moist air, either by varnishing or by putting the specimens in close-stoppered glass bottles. Total immersion in oil, naptha, and even in water, has been found in some cases effective. Glycerine is worthy of trial.

LOCALITIES FOR FOSSILS AROUND LONDON.—"SIR,—My reason for troubling you with this note is that I am anxious to obtain some information respecting the *best* localities *near London* for obtaining fossils. Your reply would much assist me in the study of geology—a science of which I am particularly fond. Apologising for intruding upon your valuable time and space, I am, &c., AMATOR NATURÆ, Cavendish-square."—The following are the chief localities around London:—For the chalk, Gravesend, Purfleet, Charlton, Erith, and Grays; for London clay, Highgate, Hampstead, Southend Cliff, and Isle of Sheppey; for other Tertiaries, Woolwich, Charlton, Erith, Bromley, Loam-pit Hill, Lewisham, and Sydenham—especially the railway-cuttings near the Crystal Palace: for (mammaliferous) brick-earth and gravel, Ilford, Brentford; for northern drift, Muswell-hill.

FIRST APPEARANCE IN EXISTING ANIMALS AND PLANTS.—"SIR,—Can you inform me at what period EXISTING SPECIES of the four vertebrate classes first appear? Also when we first meet with existing plants. Yours, &c., C. EVANS" (Hampstead) —Some geologists will not hear of the presence at the present period of animal-species older than the Pleistocene. Others think it quite possible existing species may be traced farther back in the series of geological ages. Indeed, as examples, amongst some few others, *Terebratula caput-serpentis* of our seas is quoted as being the same species as *T. striata* found in the London clay, and as probably identical with *T. striatula* of the chalk. But we must always recollect that in shells we have to do with the covering only, and not the animal. Of plants we cannot say much in this respect. The remains usually known in the fossil slate, namely, leaves and wood, are of no use in the determination of species; the really essential parts of specific value, the fruits and flowers, are comparatively rare. In the case of some of the simple Diatomaceæ, it seems to be, however, absolutely proven that, as in the case of Foraminifera, some of the same species or varieties now living have existed through enormous periods of time; some of the latter being found in the Tertiary, Cretaceous, Liassic, and even in the Mountain Limestone beds. This subject has been illustrated by Messrs. Parker and Rupert Jones, in the "Annals of Nat Hist., 1857." Of the species of mammals, all those determined as being specifically the same in the recent and the fossil state are of Pleistocene age, such as the *Felis catus*, from Grays, *Felis leo*, from Brentford, *Meles taxus*, from Kent's Hole. Remains of many existing animal forms are constantly met with also in turbaries and peat-bogs, in the still older gravels of Brentford, Grays, &c., and in the cavern-deposits, probably also of the same age as the last; but beyond the Pleistocene Tetiaries no existing species, to our knowledge, has been recognized. Some bird-remains from the cavern accumulations have been referred to lark, duck, falcon, &c. The singular recent fish *Mallotus villosus*, or Capellan, is found abundantly in clay-nodules on the coast of Greenland and in New Hampshire. Not much is known of the formation to which these nodules belong, but it is referred to the Pleistocene clays. We do not know any other example. Of reptiles we remember only the Gangetic crocodile or gavial, and the land turtle of the Sub-Himalayan deposits, which, it is said, cannot be distinguished from the species now existing in India. These reptilian remains appear to be commingled with Miocene animals.

OAK TREE FOUND IN THE TYNE.—The conservators of the river Tyne were, for some years, actively engaged in deepening the river, and removing obstructions to the shipping; one of the most formidable bars which had long defied their exertions, was Cockrane Sand, opposite to Heaton Drop, about five miles below Newcastle. In November, 1848, in the removal of this sand-bank, under the direction of Mr. Brooks, engineer, it was discovered that the cause of obstruction arose from the presence in the bed of the river of a stupendous oak tree, which, after being skilfully and securely chained to two barges at low tide, was, at high water, weighed up and carried to Newcastle, where, by means of a powerful crane, this oak tree, which measured sixteen feet six inches in circumference, and eighteen feet in length, was raised and laid on the quay. It is conjectured that it must have weighed at least fifteen tons. A tree of such dimensions, for this must be considered but a portion of the length of the stem, must lead us back to a very early period, and certain it is, from the appearance of decay, that it must have been many centuries in its last position, and that before it bowed its lofty head, it must have been of at least 400 or 500 years' growth. The surface of the side on which it reposed was covered with a metallic deposit of iron-pyrites, which, with another scaly covering of pyrites, formed a kind of gallery, in some parts a half to one and a half inches apart, having in many places the intermediate space filled up with beautiful crystals of pyrites of minute size, like fine needles. It appears clear that this tree must have fallen and remained in the position in which it was found, for below it, and embedded with it, were quantities of small pieces of branches and hazel-nuts, most of which were perforated at the top, and empty. The wood or bark, beneath the pyrites, appeared to the extent of three quarters of an inch completely charred, and, for three or four inches further, the wood, although it had not changed its colour (the laminæ being quite distinct), was yet quite decayed; after this part was removed, the rest was found to be quite sound. The magistrates directed this monument of so early a stage in the history of that part of the country to be preserved, and, having had it cut up, a part was forwarded to the *Coal Exchange* in London, then being erected in Lower Thames Street; and it now forms the dark part of the ornamental centre of the floor of that building.

J. JAMESON.

38 Arlington-square, April, 1848.

THE S. H. H. ADVERTISEMENT.—"10 St. Vincent's Parade, Clifton, near Bristol, 23 March, 1858.—SIR,—Your account for an advertisement in the February number of the GEOLOGIST, did not reach me till the last delivery on Saturday, the address being omitted. This was the first intimation I received of the insertion of the advertisement, and I instantly sent to the post-office to enquire if there were any letters for S. S. H. I find there have been many; but they have been sent to the Dead Letter Office, as they were not claimed. To those who have answered the advertisement, the return of the letters must have been very annoying, and they will suspect a trick has been played upon them. I have been confined to my house, by ill health, for nine weeks, and have not seen the GEOLOGIST; and as I received no reply to my note, I supposed both the note and the advertisement to have been thrown aside. Some explanation must now be given, and I think it will be necessary to re-insert the advertisement, with the notice enclosed, in your next number. The Editor will decide whether it is desirable to give any explanation in his 'Notices to Correspondents.' I am, Sir, your obedient servant, WM. HIGGINS."—We received the above note from the late proprietor, Mr. Parsons, of Kenilworth, after going to press with our last number.

ON SEEDS AS A SOURCE OF BITUMEN. BY MR. G. WILSON, of Wakefield.—Many have been struck with the thickness of some of our modern peat-bogs, and have hence regarded them as incipient coal-beds. Be this as it may, it is difficult to account for the quantity of bitumen in these deposits, and I offer the suggestion that the seeds of the plants growing in such places, may be one of the sources of its production. How far the seeds of the ling or of the heaths may conduce to its supply in some peats has never been properly tested, but as peat contains mineral oil—from which, of late years, candles have been manufactured—and as all seeds contain more or less oily matter, might it not be worth considering whether any evidence exists in our heaths, peat-bogs, or coal-seams, of the derivation of any portion of the bituminous matter from such a source?

FOSSIL SPONGES, CLINOMETER, &c.—φιλοζητητης, MANCHESTER.—"SIR,—I am glad to find a source of information open in your 'Notes and Queries,' to which I at once resort. I should be glad of information on the following questions:—1. Have any sponges been found in the fossil state? I ask this because I have a specimen which was found among the *débris* of mountain-limestone in Swaledale which I can assign to no other class than sponge. Yet in looking over the collection in the Manchester Natural History Museum I find no sponge—nor anything corresponding to my specimen, but I may have overlooked what I sought for. If fossil sponges are known—which I should expect—in what book are they described, or where shall I get information respecting them? 2. Mr. Page, in his Advanced Text-book, pp. 290-1, refers to the Clinometer and Aneroid. Professors are guilty of giving students too much credit in what they suppose them to know, so I presume Mr. Page supposes the two instruments mentioned above are well-known. Will some contributor to the GEOLOGIST describe the instruments, and give a few hints as to the best mode of using them, or give reference to some not very expensive book with the needed information? 3. Is there any article or treatise on Palmacites from which an amateur might gather the distinctive features of the different species? 4. What is the Etymology of Ulodendron? If from ὕλη and *ρονδενδ̀* is the word ὕλη used in a generic sense, as a forest-tree, or has it some specific meaning? I leave my enquiries to the kindness of yourself and contributors to the GEOLOGIST—hoping they are not beneath a notice in your 'Notes and Queries.'—Yours, &c."

FERN REMAINS FROM FOREST OF DEAN, FROM SAURUS, GLOUCESTER.—We acknowledge this communication, with pen-and ink outlines of the specimens, from which, they being without the slightest indication of structure, &c., we cannot determine the species. From casts, or careful drawings, of specimens, we might assist our correspondents; but, even with the actual specimens before one, it is very difficult, if not impossible, to determine specimens from fossil-leaves alone. There are no other good or cheap works on fossils than those popular treatises by Lyell, Mantell, Phillips, Ansted, &c., to which we have, in answer to other correspondents, already referred.

GEOLOGY OF ROSS.—"SIR,—Will any of your readers give me the names of the localities in the neighbourhood of Ross, in Herefordshire, that possess interest for the geological student. Will you also inform me the best method of extricating the fossils from the rocks in which they are contained."

PALATAL TEETH OF FISH, BRISTOL.—"Bristol Institution, April 10, 1858.—SIR,—If your correspondent who signs 'W. S., Bristol,' will pay a visit to our museum, I shall have much pleasure in showing him the collection of 'Palates' from the Mountain Limestone, and I shall be glad to assist him in naming the 'twenty different kinds' which he has collected. I am, Sir, yours obediently.

"WM. SANDERS."

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.—March 24.—1. "On a protrusion of Silurian Rock in the North of Ayrshire." By J. C. Moore, Esq., F.R.S., F.G.S.

The author described the coast-section of a part of North Ayr, from Ardrossan to Goldenberry Hill, north of Portencross Castle, altogether about five miles in length; and he showed that the red sandstones (of Devonian age) that succeeded the coal-measures of Ardrossan, from which they are cut off by a trap-dyke, dip southwardly for upwards of two miles, then form a low anticlinal, and are then vertical for a short distance; after which they are abruptly succeeded by a contorted and arched mass of purple, green, and black schists of Silurian age. The schist are immediately succeeded on the north by unconformable red sandstones and conglomerates, dipping northward, cut through by greenstones, and apparently belonging to a lower stage than that of the red sandstones of the south of the axis; sandstones similar to the latter succeed, with a conformable dip, and are traversed by a porphyry which forms a massive covering above them, and constitutes the picturesque hill of Goldenberry.

The author remarked that an axis of elevation has disturbed the Old Red sandstone, Coal-measures, and Permian sandstone in the Isle of Arran, at a point coincident with the above-described protruded mass of Silurian rock ten miles distant; and he pointed out that the axes of the successive movements of palaeozoic rocks of Scotland appeared to correspond with this and with each other, in having an E.N.E. strike.

2. "On the Rock-basins in the Granite of Dartmoor." By G. W. Ormerod, Esq., M.A., F.G.S.

The district examined by the author may be regarded as a central belt of this granitic district, occupying about one-third of Dartmoor, and extending over the parishes of Gidleigh, Chagford, Morton Hampstead, North Bovey, Withycombe in the Moor, Manaton, Ilington, and Bridford. Mr. Ormerod has examined most of the rock-basins occurring in this district himself, and made plans of them from measurement. In describing them, he divided the district into plots, by rivers and watersheds; and he gave a slight notice of each tor, if it possessed any features of interest. He also stated the measurements of the basins from N. to S. and from E. to W., for comparison; as well as their characters, depths, &c., and the direction of their longest diameter. Vixen Tor, Mis Tor, Hounter Tor, the Tolmen, Kestor Rock, the Puckie Stone, Middleton Hill, the Logan Stone, Hell Tor, Ingstone Rock, and Yes Tor were more especially described; and the heights above the sea-level—the presence or absence of basins on the tors—and the relative shapes and sizes of the basins were shown by tables.

After observing that though probably in some cases used by the "Druids," yet the basins were certainly not formed artificially, Mr. Ormerod proceeded to explain the differences between the "rock-basins" of the tors, the "potholes" in the granite of the bed of the Teign; and to show that atmospheric causes alone had caused the formation of the former; he further pointed out the peculiar kinds of granite that were liable to be so decomposed as to present either saucer-shaped, flat-bottomed, or other shaped basins on the surface.

3. "On the Kelloways Rock of the Yorkshire Coast." By J. Leckenby, Esq. Communicated by J. Morris, Esq., F.G.S.

The author traced this interesting deposit from a short distance to the south of Gristhorpe Bay, where it is a very thin pisolitic band, to Red Cliff, where it presents upwards of 20 feet of sandstones, the upper part being fossiliferous. At other points also near Scarborough Pier, at the Castle, and inland at Oliver's Mount, the Kelloways Rock has been found to yield numerous fossils, a list of which the author appended, together with descriptions of some new or little-known species of Ammonites from this deposit.

[This paper was illustrated by a series of fossils from Mr. Leckenby's Collection.]

April 14.—1. "On the occurrence of *Graphularia Wetherellii* in nodules from the London Clay and the Crag." By N. T. Wetherell Esq., M.R.C.S. Communicated by the President.

The author, having briefly explained the form and general characters of the Pennatula-like fossil named *Graphularia Wetherellii* by MM. Milne-Edwards and Haime, described the circumstances under which he had lately found portions of the stem of this coral traversing nodules in the London Clay of Highgate. The nodules are of various sizes, and vary from a cylindrical to an ovoidal shape. Mr. Wetherell having also observed unmistakeable fragments of the same *Graphularia* holding the same relative position in nodules from the Red Crag, differing from those of the London Clay only in having been more rounded and polished by aqueous action, brought the subject before the Society as a link in the chain of evidence of the so-called "coprolitic" or phosphatic nodules of the Red Crag having been to a great extent derived from the destruction of the London Clay. The author also offered some observations on the structure of other nodular bodies in the London Clay and in other deposits.

2. "On the Extraneous Fossils of the Red Crag." By S. V. Wood, Esq., F.G.S.

In pursuing his investigations as to the geologic age of the Crag, the author found it necessary to decide as to what are the "derivative" fossils which are mixed with the native fossils in this deposit. This has been a matter of some difficulty. Mr. Wood enumerates the following genera that may have supplied species or specimens to the Red Crag:—*Chama*, *Cardita*, *Astarte*, *Cyprina*, *Isocardia*, *Limopsis*, *Turritella*, *Vermetus*, *Cancellaria*, *Terebra*, *Voluta*, and *Pyrula*; and he observes that out of 240 species of mollusca found in the Red Crag, and belonging truly to a modern tertiary period, forty, or perhaps fifty, might be considered as derivative fossils, though possibly some of them may have lived on from the period of the lower to that of the Upper or Red Crag. Some few extraneous fossils found in the Red Crag appear to the author to have been casts of shells from some fresh-water deposit, probably of old tertiary date, but of which no other trace has been recognised. Mr. Wood regards the relics of terrestrial mammals found in the Red Crag as extraneous to that deposit, as well as the Cetotolites or relics of whales. Remains of two species of *Hyracotherium*, originally derived from the London Clay, have occurred in this Crag; also a tooth said to be of a *Coryphodon*. The remains of *Ursus*, *Canis*, *Vulpes*, *Felis*, *Trogontherium*, *Mastodon*, *Rhinoceros*, *Equus*, *Sus*, and *Cervus* have been derived from some Upper Tertiary deposits; but Mr. Wood is uncertain whether the Crag relics of *Hippotherium* and *Hyænodon* may not have come from some Middle Tertiary beds. The remains of *Balænodon* certainly were not derived from the London Clay, as has been suggestd, but with the *Delphinus*, have come from some tertiaries of a later date. Crocodile, Turtle, and Snake remains, fossil wood, crustaceans, and mollusca have come from the London Clay. Many of the fish remains are London Clay fossils; but some have been washed in from beds similar to those of Bracklesham; and some, including the teeth of *Carcharodon megalodon*, have apparently been derived from Middle Tertiary beds not existing now in this area. Some Chalk fossils, and several fossils from the Middle Oolites, have also been collected in the "phosphatic beds." Mr. Wood described the relative proportions in which the different derivative fossils occurred, and made some remarks on the general characters of these beds. He observes that probably no locality more resembles the conditions of the Red Crag Sea during the accumulation of the materials of its bed than the existing Bay of Christchurch, where the conflicting tidal currents mix the fossils of several beds with recent shells.

[The papers by Mr. Wetherell and Mr. Wood were illustrated by a large series of specimens.]

3. "On a Fossil Fruit found in the Upper Wealden deposits in the Isle of Purbeck." By Professor J. Phillips, M.A., President G. S. &c.

In one of the Upper Wealden shales in the northern cliffs of Swanage Bay, the author found a small imperfect spherical pyritous seed-vessel, about half an inch in length, which presented evidence of having had eight meridional ridges, and an apparently fibrous surface. After a careful comparison of numerous forms of seeds of monocotyledonous, gymnospermous, and dicotyledonous plants, the author considered that the specimen presented some analogies with dicotyledons of several groups, especially *Euphorbiaceæ* and *Juglandaceæ*.

[The specimen was exhibited to the meeting.]

OSWESTRY NATURALISTS' FIELD CLUB.—The meetings of this Society, appointed to be held during the present year, are at Llanrhaiadr, 10th June; Llangollen, 22nd July; Breidden Hill, 26th August.

THE MALVERN NATURALISTS' CLUB.—The annual meeting of this excellent and valuable local society was held on the 12th instant, at their museum in Great Malvern; when an instructive presidential address was delivered by the Rev. W. S. Symonds, F.G.S., who commenced by a well-merited allusion to the loss the club had sustained by the death of the late Peter Marriott, Esq., of Malvern, and then passed in review the recent additions made to those departments of science which, from local circumstances, were most interesting and familiar to a working field-club. Some astronomical matters came first in order, and then the president dwelt largely on subjects of geological interest. The curious fact was mentioned that crystallized Borium (derived from boracic acid) had recently been obtained so like the diamond, that it was difficult to distinguish the crystals of borium from the crystals of carbon. An interesting case of metamorphozed Caradoc rock (now called Llandovery beds) had recently been brought to light, near the Wind's Point, by the excavations conducted by Captain Johnson, and which Professor Morris had been induced to survey and report upon. The rock, as exhibited, was an impure limestone, forming thin bands, interstratified with greenish clays or marls; although generally unfossiliferous, a lower bend was thicker, and more calcareous, and this argillaceous limestone contained numerous casts of *Orthis* and *Pentamerus.* No portion of the original shell remained; the casts and moulds of the fossils, as well as many of the cavities of the rock, being coated with rhomboidal crystals of dolomite. In some cavities, groups of crystals are piled one on the other according to ascertained laws of crystalline arrangement; the surface of the dolomitic crystals lining the cavities being occasionally spotted with minute crystals of pyrites, generally tarnished. In some of the cavities of the limestone slender crystals of arragonite were observed. The dolomization of the rock had been suggested by Prof. Morris as due to the influence exerted by intrusive dykes. In alluding to these metamorphic deposits, the president said he had always believed that the Malverns had existed as a submarine reef of upheaved syenite, at a period anterior to the deposition of those very ancient strata, the uppermost Caradoc bed; nor was it possible to have examined the remarkable section at the Winds' Point without coming to the conclusion that those strata were deposited on the syenite, and in the hollow which now constitutes the Winds' Point; and, further, that the syenite and sandstones had been gradually upheaved to the position they now occupy. In further review of geological matters, the "Holly-bush standstone" was mentioned as a probable equivalent of the "Longmynd rocks," which had been considered devoid of fossils until Mr. Salter detected in them remains of crustaceans, zoophytes, and fucoids The Holly-bush Hill strata had furnished relics which, hitherto passed over as fucoids, were now determined by Mr. Salter to be tubes of annelides, and have been named by that gentleman *Trachyderma antiquissima.* Mr. Salter, it was stated, had noticed, last year, the occurrence of the "Ludlow bone-bed" at Hales-end, where it occupied the same relative position, in respect to the fossiliferous upper Ludlow rock below, and the Downton sandstones and tilestones above it, as at Rockhill.

The "Old Red" formation was next commented upon, and the interesting discoveries of Cephalaspides, and other ancient fish remains at Trimpley, by Mr. G. E. Roberts, of Kidderminster, noticed. The discovery of a new species of Pterichthys, by Mr. Baxter, of Worcester, in the yellow sandstone below the mountain limestone at Farlow was also referred to, and the president concluded his *résumé* of scientific proceedings with an account of antiquarian and botanical matters of much local interest.

REVIEWS.

Omphalos; or An Attempt to Untie the Geological Knot. By P. H. GOSSE. London: J. Van Voorst. 1857.

"You have not allowed for the wind, Hubert," said Locksley, in "Ivanhoe," "or that had been a better shot." "The master of the brig *Elizabeth*, which was wrecked on the coast of Newfoundland some five-and-twenty years ago," says Mr. Gosse, "had made a good observation the day before, which had determined his latitude some miles north of Cape St. Francis. And so in spite of fog, the captain steered boldly on until his ship struck on the rocks and came to destruction."

The captain had not allowed for *the polar current.* Then the planet Uranus would not travel in its orbit, as it ought to have done, but at last the secret was found out, the astronomers had not allowed *for the disturbances produced by Neptune.* And yet, after all, nature was right in all these instances. Man, himself, was wrong. Now, Mr. Gosse's book is a nice book—a good book to look at, beautifully printed, charmingly illustrated, just a little book worthy of Mr. Gosse in its appearance and address, but very unworthy of Mr. Gosse, and indeed of anybody else, in its doctrine. Mr. Gosse has not allowed for the wind, or he had been a better shot; he has forgotten the polar stream, and his argument is wrecked on the bluff coasts of Nature, and the rocks of facts; he has not allowed for the disturbances of Neptune, and his own course is erratic in consequence.

The great feature of Mr. Gosse's book is the so-called "prochronic" theory; that is to say, Mr. Gosse teaches the idea of a non-existent pre-existence for every created thing and being. This is the plain English of the doctrine after all. Mr. Gosse finds Scripturists and Geologists at variance about the seven days of Creation; and Mr. Gosse attempts to get out of the difficulty by assuming all the evidences of creation to be delusions. He sets out with these principles, that the evidence of the senses is often delusive; that the deductions of human reason are fallible; that essential considerations are often overlooked; that there *is* a discrepancy between Scripture and Geology, and that this is a painful dilemma, to escape from which none of the numerous efforts yet made have been successful. He then reviews these various attempts from the "diluvial" theories of the older writers, who attributed all geological phenomena to the deluge—to that modern doctrine of progressive development which finds for Adam, as Mr. Gosse facetiously writes, an immediate ancestor in a chimpanzee, and a remote ancestor in a maggot.

He next passes under review the strata composing the crust of the earth—the organic remains contained in them—the disturbances of the beds—internal heat—fossil footprints—bone-caves—volcanos—changes of level—and, in short, all the well-known geological phenomena.

But in all these matters—*all* these—geologists, Mr. Gosse says, are wrong; he admits the grandeur of their evidence; he acknowledges the shrewdness of their reasonings; he admires the intellect, and skill, and energy they have exhibited in working out these subjects; and after summing up the geological facts he is forced to admit—"A mighty array of evidence it certainly is, and such as appears at first to compel our assent to the sequent claimed for it. I must confess, however," he adds, "that *I have no sympathy* with the reasonings of those, however I honour their design, who can find a sufficient cause for these phenomena in the natural operations of the antediluvian centuries, or in the convulsion that closed them? But is there no other alternative?" Mr. Gosse believes there is. And, if geological inferences be untrue, so do we; but there is no alternative to truth—and truth we can only know by the evidence of our senses.

It is all very well to call geological facts only circumstantial evidence—we can have no other evidence than circumstantial of what we have not seen—and it is only by such circumstantial evidence that the case in dispute can be settled;—and, after all, is there a discrepancy between Geology and Scripture? We must not take up our Bibles and, with certain notions of our own, point out certain passages and say the Bible says so and so, and, therefore, no evidence of the senses must be allowed to contradict it. That is doing something not at all equal to circumstantial evidence—it is merely putting the theories or imaginings of an individual against facts. It is not by taking our own views of what the Bible means, and making all the world bow in homage to ourselves, but in working steadily in the fields of nature, labouring patiently in searching out how the truths of creation support the truths of revelation, that we are best doing our duty. It is not by such an application of the Bible, but by means of Geology that the reconciliation of these so-styled differences *must* be effected. Let us not begin at the wrong end, but let us search patiently and earnestly for the clue.

"Here," says Mr. Gosse, "is in my garden a scarlet runner; it is a slender twining stem, some three feet long, beset with leaves, with a growing bud at one end, and with the other inserted in the earth. What was it a month ago? A tiny shoot protruding between two thick, fleshy leaves, scarcely raised above the ground.—A month before that? The thick, fleshy leaves were two oval cotyledons, close appressed face to face, with a minute plumule between them, the whole involved in an unbroken, tightly fitting, spotted leathery coat. It was a bean, a seed. Was this the commencement of its existence?—No! Six months earlier still it was snugly lying with several others like itself in a green, fleshy pod, to the interior of which it was originally attached. A month before that, this same pod, with its contents, was the centre of a scarlet butterfly-like flower, the bottom of its pistil, within which, if you had split it open, you would have discovered the tiny bean, whose history we are tracing backwards, each imbedded in the soft, green tissue, but no bigger than the eye of a cambric needle. But, where was the flower?—It was one of many that grew on our garden-wall all through last summer; each cluster springing as a bud from a slender twining stem, which was the exact counterpart of that with which we commenced this little life history,—and this earlier stem—what of it? It, too, had been a shoot, a pair of cotyledons with a plumule, a seed, an integral part of a carpel, which was a part of an earlier flower, that extended from an earlier bud that grew out of an earlier stem that had been — and backward *ad infinitum*, for aught that I can perceive. The course of a scarlet runner, then, is a circle without beginning or end,—that is, I mean without a natural or normal beginning or end. For at what point of its history can you put your finger and say, 'Here is the commencement of this organism, before which there is a blank; here it began to exist?' There is no such point, no stage which does not look back to a previous stage on which *this* stage is inevitably and absolutely dependent." Now this argument certainly seems very strong indeed for a progressive development of created beings; but Mr. Gosse tells us that the original progenitor of this plant was suddenly created, bearing all the structural characters visible in the now living plant, and yet never having had the existence of which it displayed the evidences. Mr. Gosse gives us this cyclical progression in the shape of a circle, and then he tells us creation solves the dilemma. "Creation, the sovereign fiat of Almighty Power, gives us the commencing point which we in vain seek for in nature. But what is creation? It is," he replies, "*the sudden bursting into a circle*." Catastrophes and violence are usually terminations, certainly not a part of the ordinary state of things; nor, as far as we know, at all appropriate to the commencement or origin of either material substances or of life. There is a long series of preparations in the early condition of plants, of animals, and of mineral masses; even rocks seem to be elaborated by slow processes. One source of Mr. Gosse's error lies in the assumption that everything was created perfect—or rather adult, for Mr. Gosse does not distinguish, as he ought to do, between perfection and adultness,—which latter is something very different from perfection.

According to Mr. Gosse, the first-created plant was produced with root, stem, leaves, flowers, fruit, and seed; and showing in its structure the fallacious evidence of an existence which it never had; there were the rings of growth in the wood, the scars of the fallen leaves, and all the evidences of seasons of progression, from the seed to the perfect plant, which had never taken place, but which had only partially passed through the mind of the Creator, in *the act* of creation; that the first-made animal, in the structure of its bones and muscles, carried in it also the fallacious marks of birth, and of a general development which it never had; and that by similar fallacious evidence of ancient conditions of land and sea in the rock-masses of which the earth's crust is composed, and by the entombment in its strata of animal-like forms which never had any existence at all, the world itself is thus, like everything else, made to offer a fallacious display of an antiquity it does not possess. As if God could create anything with the impression of untruth upon it. No; assuredly, if the act of creation was sudden, the created thing or being would at once tell the character of its origin; if the world was at once created, it would show no evidence of previous stages. A man at once created would bear in his framework no evidence of a birth, an infancy, and youth, which he had not. His muscles, his bones, his flesh, his teeth, even to the very cells of which their structure was composed would show their newness; and the first man, if created *perfect*, *i.e.*, in the sense of "adult," must have differed from all his progeny. All that Mr. Gosse does in his book to prove one idea tends, without exception, to prove another; and no greater support of the gradual development doctrine has been written, since the publication of the memorable "Vestiges of Creation"—a purpose, at least, his volume does not profess to serve. We think most persons, not, in the least degree, geologists, would prefer to use their senses rather than blindly to be enslaved by such wild and hypothetical speculations, alike derogatory to the intellect of man, and to the power and wisdom of God.

A Descriptive Catalogue of the Rock Specimens in the Museum of Practical Geology; with Explanatory Notices of their Nature and Mode of Occurrence and of the places where they are found. By A. C. RAMSAY, F.R.S., Local Director; H. W. BRISTOW, F.G.S., Geologist; and HILARY BAUERMAN, Assistant-Geologist of the Survey of Great Britain. London, 1858.

ONE might think that, in a great country like this, an official catalogue of a public collection was no great matter, that it was only a reprint, with additions, of an old book of very many editions, and not at all a new thing. But no one who knows the real state of our national collections will wonder at our regarding a mere catalogue as something imperative upon us to notice. The visitor can now walk through the Museum of Economic Geology, catalogue in hand, and learn much without exposing his ignorance—which none of us like to do—of the nature and characters of the rock-specimens there located, and he can deduce from the brief descriptions in the 293 pages before him, something like reasons why those particular fragments of rocks are worthy of appearing in the cases, as well as what are the economic values and properties of the mineral masses or varieties they represent. In the South Kensington Museum an attempt had already been made to make the objects there teach something to those who go to see them; and we hail with much pleasure this work of Professor Ramsay in the same path. We trust before long to see the fossils and machinery in this museum similarly noted and explained.

THE GEOLOGIST.

JUNE, 1858.

THE IRONSTONE FORMATION OF THE FOREST OF DEAN; WITH A SKETCH OF THE GENERAL GEOLOGY AND INDUSTRIAL HISTORY OF THE DISTRICT.

By Dr. J. W. Watson, F.G.S.

It is an old remark, that much of the prosperity attending the manufacture of iron in Great Britain has resulted from the circumstance that the ore, the fuel, and the flux are mostly associated minerals in the same locality; and, although this is typically true as regards the mineral basin which forms the subject of the present article, it is somewhat curious that, in all probability, the discovery of the fuel in this instance dates much posteriorly to the employment of the ore, so that iron-making had become an active branch of industry in this district long prior to any of the numerous seams of coal being worked; and, what is equally likely, before even their existence was known. If we look into any of the early histories of Gloucestershire, we find that, while abundant mention is made of the iron-mines and the smelting furnaces, no notice whatever is afforded of the coal, fully warranting the supposition that the discovery of the deposits had not then been made. It will, perhaps, form an interesting preface to this paper, if, in connection with this latter circumstance, before entering upon the geological and lithological features of the ironstone formations, which are special and of the greatest interest, I give a sketch of the commercial history of the locality, past and present.

In tracing the progress made in the metallurgy of iron in this country, the Forest of Dean claims to have been among the first localities where the manufacture of that metal was established. And, although it is needless to enter into any elaborate conjectures as to why the district was originally selected, the circumstance that a most abundant supply existed of wood of the kinds best suited to smelting purposes—such as oak, ash, birch, &c., and the fact that the basset edges of the limestone strata, in which the principal deposits of ore occur, bring the "mine measures" to the surface, so as to mix the ore with, and render it conspicuous in, the alluvial soil, must not be overlooked, as these are certainly among the most probable causes that can be imagined. The occurrence of vast heaps of slag and scoriæ, often charged with thirty to forty per cent. of partly-reduced metal, seem to show that the earliest smelting operations were in air-bloomeries, which may be briefly described as low conical furnaces having a small opening near the ground to admit the air, and a larger orifice at the top for the introduction of the ore and fuel, as well as to allow the gases to escape. The practice in these furnaces was to stratify the ore with the charcoal, and to promote a degree of combustion sufficient to effect a gradual de-oxidation of the mineral, which, as the name air-bloomery implies, from no artificial blast being employed, was effected by selecting for the site of the furnace an elevated or exposed situation, where the winds had their greatest force. This process of reduction, however, must have been most lengthy and tedious, since nothing but a long cementation of the ore with the fuel could have caused the metallic particles to unite ; and as, even under most favourable conditions, only imperfect fusion would then be obtained, the elimination of the unreduced portions of the ore was completed mechanically under the hammer. It was these expelled and partly fused particles that formed the greater portion of scoriaceous slags, before mentioned, which have been found in such large quantities, and which, in after times, were destined to form an important source of supply to the blast-furnace properly so-called. It has been stated by the late Mr. David Mushet that, for nearly two hundred years, the blast-furnaces in the Forest of Dean used nearly one-half of these slags in a charge since it had been found highly advantageous to mix them with the calcareous ores of the district. In one of the ancient slag-heaps on the Monmouthshire side of the Forest, were found embedded some Roman coins and the remains of a sacrificial altar, which might, perhaps, enable us to assign a period to the scoriæ in regard of their antiquity; but, in all likelihood, by far the larger quantity of them were produced during the occupation of the Danes—hence the common local name "Dane's cinders."*

With the invention and introduction of the bellows, the air-bloomeries gave place to small furnaces called "blast-bloomeries," into which the air was artificially introduced; at first by human and cattle labour, but afterwards by machinery, the furnaces being removed from the elevated situations before spoken of to the lowest levels, or where the confluence of several streams gave a lasting supply of water to move the water-wheels by which the bellows were worked.

These blast-bloomeries, it may be said, formed the first real attempt towards the art of smelting, notwithstanding that not more than one-half the iron was obtained from the ores, thus adding further to the large quantity of metallic cinders accumulated under the old process. With these furnaces, however, a considerable enlargement of the manufacture rapidly followed; but the difficulty experienced in treating the ores, from their calcareous character, retarded the introduction of the blast-furnace proper for some time after its adoption in other districts. The earliest *casting* made in the Forest, according to Mr. Mushet, bears date 1620.

In an account professing to enumerate all the blast-furnaces in England, published about the year 1720, a date prior to the manufacture of pig-iron with pit-coal, it is stated that in Gloucestershire and Herefordshire, in and on the borders of Dean Forest, there were 10 furnaces, thus showing this to be the only iron-making locality that, at that time, could bear comparison in importance with Sussex and Kent, then the largest district, and where there were 14 furnaces in blast, but which, together with the iron trade of those counties, have long since disappeared amid those strange industrial revolutions which the development of our coal-fields, the increasing scarcity of wood fuel, and the progress made in the invention and application of machinery, have produced in these and other localities of former manufacturing celebrity.

Towards the middle of the 17th century, James I. was possessed of three blast-furnaces and two forges in the Forest of Dean; and the following extract from the "Miners' Customs," first framed in the reign of Edward III., and reprinted at various times up to 1800, will illustrate some of the royalties and rights exercised by the crown. The notes I have added will explain the local terms, many of which are still in use :—

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* The slag, from the ancient bloomeries in Dean Forest, was formerly carried in large quantities to Bristol for the manufacture of black bottles, the superior quality of which has been ascribed immemorially to the use of this material.

"Clause 15.—And at all times the king's man shall come into the mines without any costs asked of him, and shall be the third better man of the fellowship in maintenance and helping of the mine and of the fellowship; but the king's man, neither the lords, ought not to enter within the mine till the pit is gavelled, (*) (that is to say) for every dole (†) a penny to the king at the first time, and after, if the fellowship do make anew any other dole of which the mine (‡) of every miner travelling (§) within the said mine, the king shall have every week a penny; if so be that the miner win (‖) three seams of mine measured by the standard of the kings of old time used at the least and be it the king shall have no more.

"Clause 16.—And the king shall have every quarter of the year, of every miner travelling within the mine, a seam (¶) of mine, the which is called law-oare; and every week the gaveller (**) shall visit on Tuesday the whole mine, or, at the least, within two weeks, to receive the customs due to the king aforesaid; and, if not, the miner for the said time shall not be accountable. But if the gaveller come in the quarter to visit the mine, as is aforesaid, and find not the miner at that time, the gaveller shall receive so much of the mine as is due to the king, without leave of any.

"Clause 30.—Also, that no stranger, of what degree soever he be, but only that have been born and abiding within the Castle of St. Briavells and bonds of the Forest (that is, from Chepstow to Gloucester Bridge) as is aforesaid, shall come within the mine to see and to know the privities of our Sovereign Lord the King, in his said mine."

The last clause, relating to the privileges of the free miners, has still a modified existence under the rules and regulations appointed to be observed by the Act at present in force (1 and 2 Vic. cap. 43), which provides that free miners shall have the exclusive right of having gales

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(*) (*i. e.*) Levied of rent or royalty. (†) A share. (‡) Ore. (§) Working. (‖) Reach and work.

(¶) Bag. (**), This office is still retained under the present Act of Parliament relating to the Forest (1 and 2 Vic. Cap. 43), and the duties are the same.

or works granted to them by her Majesty's officer, called the galleler or deputy-galleler, and to open mines within the Hundred of St. Briavels and in the Forest. But to return—

The three blast-furnaces alluded to as belonging to the Crown were situated at Park End, Cannop, and Sewdely. They were planted on the sites of ancient bloomeries, probably from the ample supplies they could command of the rich slags in their immediate vicinity, which are sparingly to be found even to this day. At both Sewdely and Park End, blast-furnaces still exist, and are in operation; but Cannop works have long since been destroyed. About 1635, James demised all his iron-works to two persons named Harris and Challoner, with the condition that the free miners should furnish the furnaces with ore on the same terms that they had formerly been compelled to supply the King, as contained in the 15th and 16th clauses. I have already quoted from the "miners' customs." With this demise or grant, although there is no positive documentary evidence to back the conclusion, the Crown, in all probability, ceased to be concerned in the manufacture of iron in the Forest, and contented itself with receiving its royalties on the ores raised. Few vestiges of these royal furnaces remain, and beyond the traces of the slag-heaps, the ruined embankments of reservoirs, and the nearly obliterated water-courses, but little else exists to indicate the localities they once occupied. But this period in the history of the district is particularly interesting, inasmuch as it forms not only the history of the iron trade at that time in the Forest of Dean, but, in fact, in all England. "Far more important," says Lord Macaulay, speaking of the state of England in 1685, "has been the improvement of our iron-works. Such works had long existed in our island, but had not prospered, and had been regarded with no favourable eye by the Government and by the public. It was not then the practice to employ coal for smelting the ore, and the rapid consumption of wood excited the alarm of politicians. As early as the reign of Elizabeth there had been loud complaints, that whole forests had been cut down for the purpose of feeding the furnaces; and the Parliament had interfered to prohibit the manufacturers from burning timber. The manufacture consequently languished. At the close of the reign of Charles II. great part of the iron which was used in this country was imported from abroad; and the whole quantity cast here seems not to have exceeded ten thousand tons. At present the trade is thought to be in a distressed state if less than a million of tons are produced in a year.

From the time of the general adoption of Dudley's patent for smelting iron with pit-coal in 1740, the spread and rapid growth of this manufacture in other districts where coal was raised, caused the Forest, from ranking first among smelting localities, gradually to decline into comparative insignificance, from which, however, during the present century, it has in a great measure recovered; and, without tracing in detail the changes which have occurred, I append the following table, compiled from reliable statistical sources, which will afford a commercial summary showing the yield from the Forest mines and furnaces, commencing with the year 1828:—

Years.	Tons of Ore raised from the Mines.	Tons of Iron manufactured from the furnaces.
1828	9,800	2,600
1836	20,408	5,327
1839	72,800	18,200
1855	92,600	19,500
1856	109,268	24,132

In the commencement of this paper I adverted to the fact that the ore, the fuel, and the flux exist as associated minerals in the Forest of Dean, thus constituting an important iron-making centre; and when the central line of railroad, now in progress, and the extension-line from Coleford to Monmouth, shall have been completed, there cannot be the least doubt but that the Forest will soon take rank again with rival districts, especially when it is considered that the finest quality of iron can be produced at the lowest competitive cost.

The physical geography of the Forest of Dean presents us with an irregular elliptical basin, approaching somewhat to a triangle, two sides of which are bounded by the rivers Severn and Wye; the greatest length being in the direction of north and south, about 12 miles, and the shorter axis from east to west spanning about seven miles. The high lands take a north-easterly bearing through the centre of the area, where they are chiefly the result of valleys of denudation, and then run ridge-wise—the consequence of upheaval—round, at least, two-thirds of the basin, forming a mountain-group of which the highest point is Yorkley Hill, the average elevation being upwards of 800 feet above the sea level. The watershed is chiefly on the south-west to the Wye, and on the south-east to the Severn.

The view from Yorkley Hill, on a fine day, is possibly one of the finest of its kind in England. Looking northward, in the immediate foreground, are the steep cuttings in Old Red Sandstone of the lower road to Blakeney; and beyond, looking over the Severn, is the wide extended plain of Lias, traversed by the sinuous course of the river, which teaches, in more than one lesson, how the position of a river-channel is determined by the chance hardness or softness of a particular bed of rock—by the barriers of sand formed by reflected currents, or by a line of faults, thus disclosing, by a panoramic views facts that cannot be learnt or comprehended by mere local inspection.

Considered in its geology, *per se,* we may describe the Forest basin as limited to the old red sandstone for its base, and as having its side composed of carboniferous limestone, millstone grit, and coal measures.

I. Old Red Sandstone.

The Old Red Sandstone would entirely surround the basin, were it not that its continuity at the surface is broken on the south, where it dips beneath the limestone at St. Briavals, reappearing about two miles to the east at Bream.

The beds which immediately underlie the limestone-formation have an average thickness of about fifty yards, and are equivalent to the uppermost beds of the Devonian rocks; but, from their graduation into the limestone-series, there is probably good reason for their classification with the lowermost members of the Carboniferous group.

In the aggregate they number some thirty-five beds, which may be observed in bold section on the road from Mitcheldean to Ross, near the Lower Lea Baily enclosure, and where they are seen to consist of grey and red sandstone, with occasional thin bands of marl; the character of the sandstones being sometimes micaceous. The marls are usually claret-coloured, red, and green, but the presence of per-oxide of iron in the sandstones is rather the exception than otherwise. The resemblance between many of the upper old red sandstones and those of the true coal-measures is not a little striking, and, some years since, led to a fruitless sinking about a mile north-west from the ruins of Penhow Castle, but which might have been prevented had observations been extended further to the south-east, where the carboniferous limestone is seen to dip conformably to, and rest upon, these very strata. Much of the picturesque scenery of the road from Ross past Penyard Castle to Hope Mansell is due to highly inclined strata, forming headlands of these upper beds, the average mean dip of which, however, is not more than 25° towards the coal-field. As a rule, fossils are very rare, excepting in one seam of blue argillaceous shale, about the middle of the series, and a bed of coarse-grained yellowish sandstone near the top, where the remains of plants are tolerably numerous; there are also some impressions of shells in a thin bed of sandstone, about a foot in thickness, which immediately subtends the limestone-group.

These upper beds rest upon the conglomerate-beds, which make up a thickness of some 200 feet or more of coarse-grained sandstone, much charged with per-oxide of iron, and containing dispersed quartz and other pebbles, marl-partings, and thin bands of small pebbles, the whole interstratified in irregular, lenticular-shaped drifts, affording lozenge and diamond-shaped sections, several of which may be seen on the road across the Wye Valley, from Wilton to Ross. Many other sections, equally characteristic, are to be obtained between Ross and Monmouth.

The high grounds round the Monmouthshire side of the Forest abound with gigantic blocks and solitary tors, composed of the conglomerate, which forms the outlier known as the "Buck-stone," which is usually mistaken for, and mis-stated to be, a Druidical monument, besides having a host of other mythic legends and stories connected with its suppositious history.

The cornstones, and some members of the Old Red Sandstone, call for no notice in this place, since I have merely introduced the description, already given, of the superior beds of Old Red, from the circumstance of that deposit forming the base, as it were, of the basin, and, in conjunction with the account, next following, of the Carboniferous limestone and of the Coal-measures, making a connected sketch of the general geology of the district.

II. Carboniferous Limestone.

The Carboniferous limestone would mark a continuous band round the Forest of Dean, flanking and underlying the Coal-measures, but that it is cut off on the south-east by a down-throw fault, commencing near Blakeney Hill, a little to the east of Staple Edge enclosure; it re-appears at Red Hill, near Sydney. The effect of this fault, which is marked by a line of springs, has been this—the Coal-measures and Millstone-grit cover and repose conformably on the beds below the Old Red.

The whole of the limestone-formation may be locally divided as follows, in descending order:—

1. The "whitehead limestone" and calcareo-arenaceous red and purple-coloured shales, graduating into the lowermost beds of Millstone-grit, or the equivalent of that rock, one bed being slightly oolitic, near St. Briavils, and at Coleford. Average thickness, 40 yards.

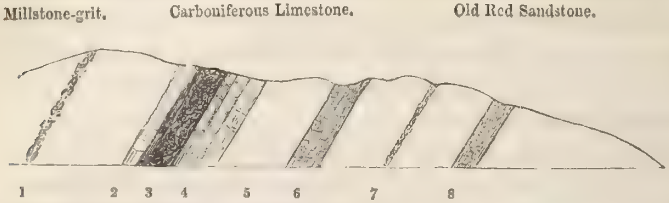
2. Grey iron-stone formation. Grey and red-limestone beds. Thickness, about 42 yards.

3. "Black-rock" limestone, calcareo-argillaceous shales, and "Foreline" limestone, often called the "Mountain-limestone," graduating into the uppermost beds of Old Red; average thickness, probably, 15 yards, but very variable.

The middle and lower divisions are moderately fossiliferous, but I am not aware of any organic remains having been discovered in the beds above the "Ironstone-formation," although, on Deans Meend, near Mitcheldean, I have observed a thin bed of purplish arenaceous limestone, on the upper surface of which there are certain ring and pipe-like markings, which may probably be considered annelidal, or made by marine worms. In a bed near the bottom of the "Grey beds" some fine specimens of "fish palates" have been found, and in the "Red beds" some entrochites of large size. These grey and red beds are highly crystalline, and average from two feet to a yard thick. The innumerable small joints, however, by which they are traversed, render the stone valueless for building-purposes, although it is most extensively quarried for the supply of the iron-furnaces, as well as for burning into lime.

But the real harvest for the palæontologist is to be gained in the carboniferous shale-partings or ancient mud-beds, which are interstratified with the thin beds of limestone and calcareo-arenaceous shales that form the transition to the Devonian beds. The series which, in all probability, represents the carboniferous shales of Devonshire is a perfect charnel-house of encrinital remains; and I know of no better spot for the collector than the section, or, in quarry-language, "loose end," which is obtained in an old quarry near the summit of Plump

Hill, about half-a-mile out of Mitcheldean, where the complete sequence of the beds is to be seen, as in the following diagram:—



1. Sandstone vein of Iron Ore. 2. White Head Limestone. 3. Limestone vein of Iron Ore. 4. Grey and Red Limestone. 5. Black rock Limestone. 6. Foreline Limestone. 7. Grey Sandstone. 8. Conglomerate.

In two thin and nearly vertical bands of shale, so rotten that it is difficult to secure a whole square foot of it, which repose respectively on beds of about a foot thick of very hard, partly crystalline, limestone, charged with a considerable per centage of sand, so thick do the ossicula lie, that in dry weather a little gentle crumbling will detach them by hundreds. Besides the trochites, portions of encrinital stems or entrochites, three, four, and even five inches long, are often to be obtained, as well as the plates of the pelvis, and a great number more or less perfect terminal branches or arms. The most common species is the Platycrinus triakonta-dactylus, or thirty-fingered encrinite, but remains of the Actinocrinus or "nave-encrinite" are also very abundant. Mingled with the Crinoidea, in the shale beds, are vast numbers of shells of Brachiopoda, including two species of Spirifer (S. striatus and S. cuspidatus), and one of Terebratula (T. hastata).

Perhaps the most interesting circumstance connected with these fossil-beds is the lesson in physical geology which may be learnt from them. We find the stems of the crinoidea attached to the bed of limestone, and growing, as it were, out from it; we find the lower portions of the stems projecting a short distance into the shale; and then we find the upper parts of these same stems broken into pieces, and the disconnected ossicula scattered about in every conceivable position, many of them crushed, and all more or less exhibiting evidence of the violence of the forces causing their destruction.

The recurrence of this condition of things, in two separate sets of beds of shale and limestone, as seen in the Plump Hill quarry, would show a return to the same condition of sea-bottom, and probably a repetition of the same physical agencies at long separated intervals of time.

(*To be continued.*)

CONTRIBUTIONS TO THE GEOLOGY OF GLOUCESTERSHIRE.

THE LIAS.

By the Rev. P. B. Brodie, M.A., F.G.S., &c., &c.

(*Continued from page* 88.)

It is one of the many striking facts of geology that, as we pass from one great group of rocks to another, we find a considerable change both in lithological and zoological characters. Sometimes the transition is abrupt and sudden, at others, slow and gradual. In the former case, the marine fauna of the older deposit had perished, and a new race sprung up and succeeded to its place; while, in the latter, there was only a gradual dying out of some species unable to exist under the changed oceanic conditions, others more hardy still continuing to flourish in the later formation. But this change of genera and species is not confined necessarily to the breaks which seem to have taken place between one great rock-system and another; it is often to be noted in a greater or less degree, as we have seen in our review of the Oolites in this county, in the minor divisions and sub-divisions of each formation. The student must also bear in mind that the strata which form the crust of the globe were, for the most part, deposited by the sea; a very small proportion only being the products of fresh water, and still fewer being purely terrestrial. Therefore, in our researches into the history of the past, we have to deal more usually with the varied inhabitants of the ancient seas, and to mark the changes which took place from time to time as we pass through either entire periods, or the parts and details into which they may be divided. If we could walk along the bed of the ocean, and look with admiration and awe on the wonderful and beautiful creatures which people its depths and its shallows, we should know more of their living history, their habits, and their structure, than we do; and many a supposed fact would have to be set aside, and many a lesson would have to be learnt, perhaps, by the very wisest amongst us. Many, then, will hear with surprise (if they hear it for the first time) that the ground on which they tread once formed the bottom of the sea—perhaps at some dark, unfathomable depth inhabited by strange, uncouth monsters, which have no representatives in the present age. He who wishes to study the records of past creations has the sea-bottom at his feet, as it were, and can exhume the relics of its once teeming population from their stony tomb. If, however, the geologist has this advantage over the naturalist, he has often only the skeletons, or, indeed, but mere imperfect remnants by which to decipher and restore the forms and attributes of ancient creatures; while the naturalist, though he cannot walk beneath the waves, still can, by the aid of the dredge, collect the animals in their full symmetry and beauty. The student of the pre-adamitic earth has, however, a no less delightful task, and the very labour and the difficulty of the restorations bring their own reward, in making known to others the marvellous works of God in the earliest ages. In this spirit let us review the history of the Lias, and it shall tell its own story as we proceed.

The Lias has a very extensive range in Gloucestershire, and consists, for the most part, of alternating beds of clays, limestones, and shales, and towards the middle includes a thick and important mass of sandstone. Lithologically it presents a very different aspect from the Oolites above it, as the student cannot fail to observe. It contains a great abundance and variety of organic remains, the greater part of which are peculiar, some being limited to particular zones (especially the Ammonites), and others occurring indiscriminately throughout the formation, which presents, as a whole, a great uniformity of structure and details, and consequently can be most readily recognised in different and distant localities, even without the aid of characteristic fossils. In general, no cautious geologist would venture to determine a rock by mere similarity of lithological character, the only safe rule to distinguish the same formation in another country being by its relative position with regard to other superior or inferior rocks, and its organic remains. The Lias is essentially a muddy deposit, and from the regular layers of which it is made up, and which may be seen even in a small section, the term Lias appears to have been derived. In Gloucestershire, it is divided into upper, middle, and lower, distinguishable from each other by their order of superposition and their peculiar fossils. The upper and middle divisions form the base of the Cotswold Hills, and their detached outliers; while the lower division, here and there constituting lesser elevations, for the most part spreads over the vales of Gloucester and Berkeley, and occupies the whole of the comparatively level tract between the Cotswold Hills on the east and the Red Marl on the west, its narrowest point being the more central region in the neighbourhood of Gloucester. The course of the Lias, like that of the Oolite, is from north-east to south-west. The lower Lias is the thickest, being estimated at 600 feet in the district round Cheltenham; whilst the middle Lias, or Marlstone series, does not exceed 115 feet; but the upper averages from 230 to 270. These deposits thin off very much in their course towards the east, south-east, and south, as may be readily seen by an examination of the sections at Burford, on the east, and Wotton-under-edge on the south. As the upper Lias always forms either a portion of the outer Cotswolds or their outliers, it is there only that it is to be looked for. These lower slopes are, however, usually covered with a vast amount of Oolitic *débris*, and overgrown with grass; it is, therefore, very seldom, and only with great difficulty, that this portion of the Lias can be detected. The wet spongy soil, and the projecting platform of the hard Marlstone below, are often the only indications of this mass of shales and clay, from which the student will not be very successful in obtaining fossils near Cheltenham; though possibly some may be procured from the few sections exposed at Colesbourn, Crickley, and Holcomb, near Painswick. Many years ago there was a good section beyond the turnpike-gate at Dowdeswell, but it is now scarcely visible. We should, therefore, recommend a day or two spent at Alderton and Dumbleton, two very picturesque hills, eight miles nearly due north of Cheltenham. There the upper Lias and Marlstone are well exhibited, and in a comparatively short time a fair collection of the characteristic fossils may be made. There is a tolerable inn at Beckford, not far off, and from this point the student would be enabled to study the interesting outlier of Bredon Hill, the highest of the Cotswold outliers, exhibiting, what few of the others do, a considerable thickness of Inferior Oolite, with the upper and middle Lias beneath. The scenery, too, of these hills is particularly striking, and adds to the interest of their geology. The views from them present many different aspects, and their varied features can only be duly appreciated by seeing them at many and different spots. Bredon Hill, for example, affords a fine view of the Syenitic range of the Malverns, the rich Liassic vale of Evesham, the Silurian hills of Abberley, beyond Worcester, the Keuper ridge of Inkberrow, and the more distant plain of Gloucester, bounded by the hills of Cleeve, Leckhampton, and others, which, from their commanding height, more immediately catch the eye.

Bredon has the advantage, too, of the Avon flowing at its base on one side,—for a river always adds to the beauty of any landscape—and the absence of this is almost the only defect in the general scenery of the outer escarpments of the Cotswolds, since the Severn can only be distinctly seen from the more southern hills, as Robinswood, near Gloucester, and others in that direction. From Alderton Hill a fine view may be obtained, both of Bredon, the Malverns, the hills about Gretton, Stanley, Winchcomb, and Sudeley, with their well-wooded, grassy slopes, and the ramifying valleys which intersect them.

The geologist will carefully notice the scenery, not only for its own sake, but for its value in the physical geography of a country. It is not enough merely to examine a section in a quarry, and to note the zoological contents of the beds; a much wider survey must be taken of those grand phenomena which have, at various and immeasurably distant periods, affected the crust of the earth, upraising deep-seated rocks, and causing, in various ways, the present configuration of its mountain-chains and valleys, regulating its river-courses, and giving to the outer surface of the globe its present diversified outlines, so attractive to the eye and so serviceable to man.

To violent and often repeated igneous action in former times, must be attributed the breaks and dislocations, whether of upheaval or depression, of which (in technical language termed "faults") many instructive examples may be seen on the southern side of Bredon Hill, at Dumbleton and Oxenton, and in many other localities of the Lias, especially in the neighbourhood of Tewkesbury, where an extensive fault, traversing both the Lias and Red Marl, may be traced for a considerable distance.

Returning from this digression, we will now ascend Alderton Hill; passing over the lower Lias, which is there no where laid bare, we reach the Marlstone, which is partially quarried, but not to its entire thickness. On this the upper Lias immediately reposes, its lower portion only being visible; the main mass forming the top of the hill which is covered by a thick plantation, so that only about twenty feet of the rock appears. Nearest the Marlstone it consists of a blue indurated clay, containing many fossil shells, especially a pretty species of Rostellaria, very difficult to extract entire. The beds above are chiefly shale, varying in colour and consistency, the colours brown and grey prevailing. Many fossils may also be found in it, chiefly Ammonites, which are abundant, but very fragile; and at

Gretton, masses of a small species of Cidaris, with attached spines, occur. Traversing this shale is a comparatively thin band of nodular limestone, white on the upper and under surfaces, and blue in the centre, very hard when first dug out, but, when weathered, splitting into thin slaty masses, which are sometimes crowded with minute univalve shells. But the most interesting organic remains which have been found in it are those of fish and insects, both of which are sometimes met with nearly entire. Amongst the former the little *Leptolepis concentricus* is the most common, although other genera and species have been found. Amongst the latter the fine and unique dragon-fly, *Æshna Brodiei*,* is the most worthy of notice. Detached wings of Libellulidæ, and wings and bodies of insects of other families and orders, are associated with the more common kinds, but rarely found entire, notwithstanding the nervures of the wings are often retained with wonderful delicacy on the stone; and it may well excite our surprise that such fragile creatures as insects should be preserved at all. The land from whence they were carried out to sea, or over which they winged their flight, was probably not far distant; and the adjacent Malverns, and the Silurian country on the west, apparently formed the coast on which the Lias was deposited. A few imperfect fragments of plants are the only other terrestrial relics as yet detected; but so little of the upper Lias is exposed in Gloucestershire, that no fair estimate can be given of the cotemporary forms of animal life which may have inhabited the land at that epoch.

Much more might be said about these insects, but as we hope, in a future communication, to describe them more fully, we shall defer the details until then.

The internal shells of a species of cuttle-fish, one of the curious tribe of Cephalapods to which the fossil Ammonites and Belemnites belong, are now and then found in tolerable perfection in this limestone. Connected with this horny pen is a singular apparatus termed the ink-bag, which, in the recent animal, is used as a means of defence against the attacks of its enemies. This organ sometimes occurs in such perfection in the extinct species that its contents may still be used as a pigment; and we have seen a sketch of one of these fossil pens with its associated ink-bag, drawn by our friend Professor Buckman with

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* This is described and figured in the Quart. Journ. Geo. Soc. 1848, Vol. V., pl. 2, p. 35. R.P.B.

its own ink—an honour which this predaceous mollusk could never have contemplated.

The quarry at Dumbleton, a little further round the hill to the east, affords a similar section; but, if anything, the fossil-insect-bed is thicker there. As our remarks in this article refer solely to the geology of Gloucestershire, it would be out of place to say much about similar deposits elsewhere; but we may just observe that this limestone, with the like fossils, has been traced in other counties, especially in Somersetshire, where it has yielded to the energetic researches of Mr. C. Moore, ofBath, a rich harvest of organic remains. It may be noticed also at Gretton, where a fine specimen of a large fish, a species of Pachycormus,* was not long since procured; and we have detected it, though much reduced in thickness, being scarcely an inch thick, at Churchdown Hill, one of the outliers before alluded to between Gloucester and Cheltenham. In all probability, therefore, it will be discovered wherever the upper Lias itself is present, and the extension of so thin a calcareous band, characterized by nearly similar fossils, over a very considerable area, is a fact worthy of attention. The collector may search over a good deal of this limestone without success, and yet he must never despair, for, when we discovered the fine dragon-fly above-mentioned, it so happened that a geological friend had broken up a large block all but a small fragment, and in this the nearly perfect Æshna was lying, with its expanded wings spread out in their natural position of flight, or as if laid out with all the skill and care of an accomplished entomologist.

We must now proceed to give some account of the Marlstone on which the upper Lias rests in this county. The upper portion consists of a rough, very hard stone, of a blue colour internally and of a brown colour externally; the lower part is more sandy, with masses of sandstone and iron-nodules. It is to obtain this rock that the upper Lias clay is quarried, as it forms a useful stone for walls and roads, although, owing to the introduction of the mountain-limestone from Bristol, it is not so often employed as it used to be. It presents a very different lithological aspect to the muddy deposits above and below it; and, from its indestructible nature, it forms a very good geological horizon in this and most other districts where it prevails. It abounds in marine shells, especially those which would be suited to live in a sandy bottom. Ammonites and Belemnites are in unusual numbers, and many of them of great size. It is also distinguished by some very large Pectens, and a fine Gryphæa (*G. gigantea*), a species of Pinna, and by univalves equally gigantic. Most of the fossils exist in the form of casts: and the ancient genera, Spirifer, Leptæna, Orbicula, and Lingula, so abundant in the older formations, still linger here. Remains of Pentacrinites, one of the most curious and beautiful of the Crinoidea, vertebræ of Ichthyosauri, with the solitary humerus of a Pterodactyle, have also been noticed. The stone is hard, and the fossils difficult to extract in consequence; yet, from their abundance and variety, the collector is sure to secure a characteristic and instructive series. The most prolific localities in Gloucestershire are the quarries at Bredon, Alderton, Dumbleton, Gretton, Churchdown, and Hewlett's Hill, close to Cheltenham.

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* Many species of this curious genus have been met with at Whitby, and in the upper Lias at Ilminster. R.P.B.

(*To be continued.*)

BRITISH FOSSILS, STRATIGRAPHICALLY ARRANGED.

By John Morris, F.G.S.

I. PALÆOZOIC SYSTEM.

(*Continued from page 194.*)

C. LLANDOVERY ROCKS, OR MIDDLE SILURIAN.

Wales, Shropshire, &c.	Cumberland.	Scotland.	Ireland.
Upper Llandovery May Hill Sandstone Lower Llandovery Plynlymon rocks.	Hard siliceous sandstones or Coniston grits.	Shelly sandstones and shales of Saugh Hill, and Mulloch Hill, Ayrshire.	Conglomerates, sandstones, and schists, near Maam, &c. Galway, Uggool, Mayo.

The Llandovery rocks were so named by Sir R. Murchison from the locality in South Wales where they are most fully developed, and where their physical relations to the formations above and below them are clearly exposed. These rocks constitute an intermediate place in the Silurian table, connecting, by some of their contained organic remains, the fauna of the upper and lower Silurian groups. The upper Llandovery rock contains many shells common to the Wenlock beds, and is considered to form the natural base of those deposits; on the other hand, the lower Llandovery is related by its fossils to the Caradoc beds below, and both members of this formation are united by having certain fossils in common and peculiar to them, but are chiefly characterized by the abundance of some species of Petraia, Atrypa, and especially Pentamerus. This group consists of soft, argillaceous sandstones and building stones (Goleugoed), shales, some calcareous bands, hard, coarse grits, and quartzose, pebbly conglomerates. Thickness 2,000 to 3,000 feet.

Localities.—Both members of this group, and their relations to the overlying and subjacent rocks, are well exhibited at Noeth Grüg, near Llandovery, South Wales. In Radnorshire, Shropshire, and Hereford, the upper member, or *Pentamerus oblongus* zone, is alone present, and is seen in some places to be unconformable to the Longmynd and Caradoc rocks. The conglomerates of the west flank of the Malverns, and the sandstones of May Hill and Huntly, Gloucestershire, are of this age.

CHARACTERISTIC FOSSILS OF THE LLANDOVERY ROCKS.

Trilobita.—Encrinurus punctatus, Phacops Stokesii.

Brachiopoda.—Rhynchonella angustifrons, Orthis virgata, O. reversa, Pentamerus lens, P. undatus, P. oblongus, Lingula crumena, Strophomena pecten, Atrypa hemishærica, A. crassa, A. marginalis.

P *Gasteropoda.*—Holopella cancellata.

Zoophyta.—Petraia subduplicata, P. elongata, P. bina.

FOSSILS OF THE LLANDOVERY ROCKS.

Plantæ.

Fucoids in Malvern sandstone, Sil. p. 106.

Zoophyta.

Favosites Gothlandicus, *Lam.* S. S. 682.
alveolaris, *Blainv.* Man. 402.
Goniophyllum pyramidale, His. *Leth.*
Heliolites interstinctus, *Wahl.*
(*Porites pyriformis*, Sil. Syst.)
subtilis, *M'Coy*, P. F. 17.
tubulatus, *Lons.* S. S. 687.
Halysites catenularius, *Linn*, Sil. 685.
(*Catenipora escharoides*)
Nebulipora.
Palæocylus porpita, *Linn.* sp.
Petraia æquisulcata, *M'Coy*, P. F. 39.
bina, *Phil.* P. F. 4. Sil. 242.
elongata, *Phil* P. F. 6.
subduplicata, *M'Coy*, P. F. 40.
Syringopora serpens, *Goldf.* S. S. 675.
Graptolithus priodon, *Bronn.*
(*G. Ludensis*, S. S. p. 694.)

Echinodermata.

Pleurocystites Rugeri, *Salt.* Sil. p. 229.
Crinoid stems, Sil. Pl. 10. f. 1.

Crustacea.

(*Entomostraca—Trilobites*)
Acidaspis Brightii, *Murch.* S. S. 658.
Asaphus latifrons, *Portl.* G. R. 292.
(*Stygina, Salter.*)
Bumastus Barriensis, *Murch.* S.S. 656.
Cyphaspis megalops, *M'Coy, sp.* P.F.143.
Calymene Blumenbachii, *Brong.* S.S.653.
Encrinurus punctatus, *Brünn.* Sil. 230.
Illænus Bowmani, *Salt.* G. S. 2, p. 339.
Lichas laxatus, *M'Coy*, S. F. 51.
Cheirurus bimucronatus, *Murch.* S. S. 377.
Phacops caudatus, *Brünn.* S. S. 654.
Downingiæ, *Murch.* S. S. 655.
Stokesii, *Edw.* S. S. 656.
Weaveri. *Salt.* Dec. 2, p. 7.
Proetus latifrons, *M'Coy*, S. F. 49.
Pterygotus *spec.* Sil. 106, 235.

Annelida.

Cornulites serpularius, *Schl.* S. S. 627.
Tentaculites anglicus, *Salt.* Sil. t. 1. f. 3.
Tentaculites ornatus, *Sow.* S. S. 628.

Bryozoa.

? Nidulites favus, *Salt.* Sil. 203.
Ptilodictya dichotoma, *Portl.* G. R. 339.
Ptilodictya lanceolata, *Lons.* S. S. 676.
scalpellum, *Lons.* S. S. 676.

Brachiopoda

- Atrypa crassa, *Sow.* S. S. 636.
  - hemisphærica, *Sow.* S. S. 637.
  - marginalis, *Dalm.* S. S. 624.
  - reticularis, *Linn. sp.* 614.
    - (A. *affinis*, Sil. Syst.)
- Discina (*Orbicula*).
  - implicata, *Sow. sp.* S. S. 625.
- Leptæna scissa, *Salt.*
  - sericea, *Sow.* S. S. 626.
  - transversalis, *Dalm.* S. S, 629.
- Lingula crumena, *Phil.* G. S. 369.
  - parallela, *Phil.* G. S. 370.
- Orthis Actoniæ, *Sow.* S. S. 639.
  - biforata, *Schlot. sp.* Cat. 139.
  - biloba, *Linn. sp.*
    - (*Sp. sinuata*, S. S. 630.)
  - calligramma, *Dalm.* Sil. 231.
  - elegantula, *Dalm.* Sil. 231.
  - insularis, *Eichw.*
  - lata, *Sow.* S. S. 640.
  - occidentatis, *Hall.*
  - protensa, *Sow.* S. S. 638.
  - reversa, *Salt.* Sil. 230.
- Pentamerus globosus, *Sow. sp.* S. S. 637.
  - lens, *Sow.* Sil. 230.
  - liratus, *Sow.* Sil. 230.
  - oblongus, *Sow.* Sil. 230.
  - undatus, *Sow. sp.* Sil. 230.
- Rhynchonella angustifrons, *M'Coy.* P. F. 199.
  - decemplicata, *Sow.* S. S. 641.
  - didyma, *Dalm.* S. S. 614.
  - furcata, *Sow.* S. S. 640.
  - borealis, *Schlot.*
  - cuneata, *Dalm.* S. S. 625.
  - Grayi, *Dav.* Sil. 250.
  - neglecta, *Sow.*
  - nucula, *Sow.* S. S. 250.
  - obtusiplicata, *Hall.*
  - pusilla, *Sow.* S. S. 641.
  - serrata, *M' Coy*, Sil. 230.
  - sexcostata, *M' Coy*, S. F. 41.
  - tripartita, *Sow.* S. S. 641.
- Strophomena arenacea, *Salt.* Sil. 231.
  - bipartita, *Salt.*
  - antiquata, *Sow.* Sil. 251.
  - compressa, *Sow.* Sil. 230.
  - depressa, *Dalm.* M. C. 459.
  - euglypha, *Dalm.* S. S. 622.
  - pecten, *Linn.* Sil. 251.
  - funiculata, *M'Coy*, Sil. 251.
- Spirifer elevatus, *Dalm.*
  - trapezoidalis, *Dalm.* S. S. 610.
  - (*S. octoplicatus*, Sil. Syst.)
  - plicatellus, *Linn.*
    - (*S. radiatus*, Sil. Syst.)

Lamellibranchiata (Monomyaria).

- Pterinea bullata, *M'Coy*, S. F. 23.
  - lineatula, *D'Orb.* Prod. 33.
  - planulata, *Conr.* Sil. 253.
- Pterinea retroflexa, *Wahl.* S. S. 609.
  - sublævis, *M Coy*, S. F. 23

Lamellibranchiata (Dimyaria).

- Anodontopsis bulla, *M'Coy*, Sil. 254.
- Lyrodesma cuneata, *Phil*, G. S. 2. 366.
- Nucula (*Ctenodonta ?*)
  - deltoidea, *Phil.* G. S. 2. p. 366.
  - Eastnori, *Sow.* S. S. 635.
  - lingualis, *Phil.* G. S. 2. p. 367.
  - ovalis, *Sow*, S. S. 609.
  - rhomboidea, *Phil.* G. S. 2. p. 367.
  - subæqualis, *M' Coy*, *sp.* P. F. 283.
- Nucula subcylindrica, *M Coy*, S. F. 19
- Mytilus mytilimeris, *Conr.* Sil. 254.
  - ovalis.
- Orthonotus semisulcatus, *Sow.* S. S. 617.
  - rotundatus, *Sow. sp.* S. T. 613.
- Pleurorhynchus (*Conocardium*).
  - pristis, *Salt.* S. F. 71.
- Goniophora cymbæformis, *Sow.* Sil. 253.

Gasteropoda.

- Acroculia haliotis, *Sow. sp.* S. S. 625.
- Cyclonema ventricosa, *Hall.*
- Euomphalus funatus, *Sow.* M. C. 450.
  - sculptus, *Sow.* S. S. 626.
- Holopella (*Turistella, sp.*).
  - cancellata, *Sow.* Sil. 230.
  - gregaria, *Sow. sp.* S. S. 603.
  - obsoleta, *Sow. sp.* S. S. 603.
  - tenuicincta, *M' Coy*, P. F. 304.
  - plana, *M Coy*, S. F. 12.
- Loxonema, *spec.*
- Murchisonia cancellatula, *M' Coy*, P. F.
  - pulchra, *M' Coy*, S. F. 16.
- Murchisonia simplex, *M' Coy*, P. F. 294.
- Macrocheilus fusiformis, *Sow.* S. S. 642.
- Pleurotomaria angulata, *Sow.* S. S. 641.
  - Pryccæ, *sp. Sow.* S. S. 642.
- Helminthochiton Griffithi, *Salt.* S. F. 71.
- Raphistoma lenticularis, *Sow.* S. S. 642.
- Trochus Moorei, *M' Coy*, P. F. 297.
  - multitorquatus, *M' Coy*, S. F. 15.
- Turbo tricinctus, *M' Coy*, *sp.* 14.
  - trochleatus, *M' Coy*, S. F. 12.
  - tritorquatus, *M' Coy*, S. F. 12.
  - crebristria, *M' Coy*, P. F. 295.

Heteropoda.

Bellerophon bilobatus, *Sow.* S. S. 643.
dilatatus, *Sow.* S. S. 627.
subdecussatus, *M'Coy*, P. F. 311.
Bellerophon trilobatus, *Sow.* Sil. 230.
expansus. *Sow*, S. S. 613.

Pteropoda.

Conularia Sowerbyi, *Defr.* Sil. 234.
quadrisulcatus, Sil. syst.
Cyrtolites Scoticus, *M'Coy*, P. F. 301.
Pterotheca transversa, *Salter*, Sil. 218.

Cephalopoda.

Lituites cornu-arietes, *Sow.* S. S. 643.
undosus, *Sow. sp.* S. S. 642.
Cyrtoceras approximatum, *Sow.* S. S. 642.
Orthoceras Barrandei, *Salt.* G. J. 7. t. 9.
angulatum, *Wahl.* Sil. 234.
approximatum.
bilineatum, *Hall*, P. N. Y. t. 43
bullatum, *Sow.* Sil. 234.
Orthoceras conicum, *Satl.* S. S. 642.
coralliforme, *M'Coy*, S. F. p. 8.
tenuicinctum, *Portl.* G. R. 371.
tenuistriatum, *Münst.*
ibex, *Sow.* S. S. 613.
Phragmoceras compressum, *Sow.* Sil. 235.
Tretoceras bisiphonatum, *Sow.* Sil. 235.

D. UPPER SILURIAN, (Murchison.)

Silurian, *Sedgwick;* Murchisonian, *D'Orbigny;* Upper Silurian, *Phillips, Lyell, Jukes,* &c.

Wales, Shropshire.	Cumberland, &c.	Scotland.	Ireland.
Tilestones. Downton sandstone.	Tilestones.		Slates.
Upper Ludlow, Aymestry limestone, Lower Ludlow, Wenlock limest., Wenlock shale, Woolhope limest. Denbigh grits, Tarannon shale.	Coarse grits, flags, slates, limestone, (Kendal group, Sedgwick.) Windermere rocks, (Sharpe.) Ireleth slates, limestones, grits, coarse slates, (Ireleth group, Sedgwick.)	Lesmahago schists, dark-coloured schists and clay slates, with calcareous nodules, Lanarkshire. Schistose strata of the Pentland Hills.	Grey flags and slates, 1,000 ft. Grey flags and slates, purple slates and grits, with beds of felspathic ash, 2,500 ft. Dingle, Clogher, &c., Ughool, Mayo.

In the typical district of Siluria—the border counties of England and Wales, the Upper Silurian group consists of argillaceous, arenaceous, and calcareous strata, or shales, mudstones, sandstones, conglomerates, argillaceous and concretionary limestones, indicating different conditions of accumulation, and probably varying from littoral to deep-sea deposits, the limestones showing periods of repose, of coral growth, and a greater abundance of organic life than the shaly and arenaceous sediments. This group is subdivisible into an upper and lower series—the Ludlow and Wenlock rocks, with the thickness of about 6,000 feet. In other districts, the thickness varies, and the calcareous bands are less abundant; thus the Woolhope, Wenlock, and Aymestry limestones are but indistinctly exhibited towards the west of the typical country. In Scotland and Ireland, also, these strata present a more arenaceous, and sometimes conglomeratic, character.

The upper Llandovery rocks or May Hill sandstone of Professor

Sedgwick, noticed in the last section, are considered to form the base of the Upper Silurian series, not only by their fossil contents, but it being difficult to draw any well-defined line between them and the overlying Wenlock beds—thus constituting, with the Lower Llandovery, an intermediate zone between the underlying and overlying Silurian rocks.

The fossils of this group are nearly all marine, and belong chiefly to the *Invertebrata*; the *Vertebrata* being represented by a few remains of fishes (Placoid), and those found in the uppermost beds of the series. On the other hand, the Invertebrata are fully represented; of the Zoophytes there are many genera and species of the four-starred corals; of the Crustacea, many Trilobites, and some higher forms, as the Pterygotus and allies in the Upper Ludlow; of Mollusca, numerous species of Cephalopoda, Brachiopoda, Lamellibranchiata, and Holostomatous Gasteropods; of the Echinodernata, are many crinoids and some star-fishes; of the Annelida, are remains of sea-worms. Traces of plants (Lycopodiaceæ) have been found in the Upper Ludlow.

Principal Characteristic Genera.—Zoophyta: Aulacophyllum, Cænites, Cladocora, Cystiphyllum, Goniophyllum, Omphyma, Palæocyclus, Thecia. *Bryozoa:* Fenestella. *Brachiopoda:* Obolus, Siphonotreta, Athyris, Orthis, Retzia. *Lamellibranchiata:* Cardiola, Clidophorus, Ctenodonta, Grammysia, Orthonota. *Gasteropoda:* Holopella, Murchisonia. *Echinodermata:* Apiocystites, Crotalocrinus, Echinoencrinus, Enallocrinus, Dimerocrinus, Eucalyptocrinus, Marsupiocrinus, Paleaster, Palasterina, Prunocystites, Pseudocrinus, Palæocoma. *Crustacea:* Deiphon, Proetus, Pterygotus, Cyphaspis, Encrinurus, Ceratiocaris, Leperditia.

FOSSILS OF THE UPPER SILURIAN.

PLANTÆ.

Actinophyllum plicatum, *Phil.* M. G. S. 2, 386.
Chondrites antiquus, *Brong*, Hist. p.
Chondrites regularis, G. J. 11. p. 473.
Lycopodiaceæ, *Hooker*, G. J. 9. p. 8.

AMORPHOZOA.

Acanthospongia Siluriensis, *M'Coy*, S. F. p 67.
Cliona antiqua, *Portl.* G. R. p. 360.
Cnemidium tenue, *Lonsd.* S. S. p.

ZOOPHYTA (Anthozoa).

Acervularia ananas, *Linn.* Sil. 243.
Alveolites Bechei, *Edw.* Sil. 132.
  fibrosa, *Lonsd.* S. S. 681.
  Grayi, *Edw.* Arch. Mus. 5. 258.
  oculata, *Goldf.* Pet. t. 65.
Arachnophyllum typus, *M'Coy*, P. F. 38.
  difluens, *Edw.* Arch. Mus. 5. 431.
Aulacophyllum mitratum, *His. sp.* Leth. Suec. p.
Aulopora = Syringopora.
Chætetes Bowerbanki, *Edw.* Arch. Mus. 5. 272.
  Fletcheri, *Edw.* Arch. Mus. 5. 271.
  pulchellus, *Edw.* Arch. Mus. 5. 271.
Cladocora sulcata, *Lons.* S. S.
Clysiophyllum vortex, *M'Coy*, P. F. 52
Cœnites intertextus, *Eichw.*
  juniperinus, *Eichw.* Sil. 133.
  labrosus, *Edw.* Arch. 5. 302.
  linearis, *Edw.* Arch. 5. 302.
  strigatus, *M'Coy*, P. F. 22.
Cyathaxonia Siluriensis, *M'Coy*, P. F. 36.
Cyathophyllum articulatum, *Wahl.* Sil. 243.
  Loveni, *Edw.* Arch. Mus. 5. 364.
  recurvum, *Edw.* Arch. 5. 368.
  truncatum, *Linn. sp.* Sil. 243.
  angustum, *Lonsd.* S. S. t. 16.

- Cystiphyllum brevilamellatum, *M'Coy*, P. F. 32.
  - cylindricum, *Lonsd.* Sil. 243.
  - Grayi, Arch. *Mus.* 5. 465.
  - Siluriense, *Lonsd.* Sil. 243.
- Diphyphyllum flexuosum, *D'Orb.* Prod. 48.
- Favosites alveolaris, *Blainv.* Sil. 132.
  - cristatus, *Blum.* Sil. 132.
  - Gothlandicus, *Linn.* Sil. 132.
  - Hisingeri, *Edw.* Arch. 5. 240.
  - multipora, *Lons.* S. S. 683.
  - oculatus, *Goldf.* Sil. 132.
- Fistulipora decipiens, *M'Coy*, P. F. 11.
- Goniophyllum Fletcheri, *Edw.* Arch. 5. 405.
- Halysites catenulatus, *Linn.* Sil. 133.
  - (*Catenipora*, Sil. Syst.)
- Heliolites, (*Porites, Lons.*)
  - interstinctus, *Wahl*, Sil. 132.
  - (*Porites Pyriformis*, Sil. Syst.)
  - megastoma, *M'Coy*, *sp.* P. F. 16.
  - Murchisoni, *Edw.* Arch. 5. 215.
  - petalliformis, *Lons.* Sil. 132.
  - scita, *Edw.* Arch. 5. 222.
  - tubulatus, *Lons.* Sil. 132.
- Labechia conferta, *Lons. sp.*
  - (*Monticularia.* Sil. Syst.)
- Nebulipora papillata, *M'Coy*, P. F.
- Omphyma turbinata, *Linn.* Sil. 243
- Palæocyclus Fletcheri, *Edw.* Arch. 5. p. 205.
  - porpita, *Linn.* Sil. p. 242.
  - præacutus, *Lons.* S. S.
  - rugosus, *Edw.* Arch. 5, 206.
- Petraia bina, *Londs.* Sil. 242.
  - subduplicata, *M'Coy*, P. F. 40.
  - uniserialis, *M'Coy*, P. F. 41.
- Ptychophyllum patellatum, *Schl.* Sil. 242.
- Sarcinula organum, *Linn.* Sil. 203.
- Stenopora fibrosa, *Goldf.* Sil. 132.
- Strephodes pseudoceratites, *M'Coy*, P. F 30.
  - trochiformis, *M'Coy*, P. F. 31.
  - vermiculoides, *M'Coy*, P. F. 31.
- Stromotopora striatella, *d'Orb.* Sil. 240.
- Strombodes Bechii, *Edw.* Arch. 5, 428.
  - Wenlockensis, *M'Coy*, P. F. 34.
- Syringopora (*Aulopora*).
  - bifurcata, *Lons.* Sil. 133.
    - (*Aulopora serpens*, Sil. Syst.)
  - filiformis, *Goldf.* S. S. 685.
  - Londsdaliana, *M'Coy*, S. F. 65.
  - Orbiguiana, *Morris*, Cat. 67.
- Thecia Grayana, *Edw.* Arch. 5. 307.
  - Swindernana, *Goldf.* Sil. 242.
- Zaphrentis conferta, *M'Coy*, P. F. 28.

ZOOPHYTA (Hydroida ?)

- Graptolites priodon, *Bronn.*
  - (*G. Ludensis*, Sil. Syst. 694.)
- G. Flemingii, *Salt.* G. J. 8. t. 21.
- Retiolites Geinitzianus, *Barr.* Grapt. Bohem. 69.

(*To be continued.*)

THE COMMON FOSSILS OF THE BRITISH ROCKS.

By S. J. Mackie, Esq., F.G.S., F.S.A., &c., &c.

CHAPTER II.

The Rocks and their Teachings.

(*Continued from page* 137.)

A man would see but little of the reality of the world if he shut himself up in his house, and only gazed out from the same window; he would learn little more if he contented himself with alternately gazing upon the scenes passing around him, from the windows of every storey. So a geologist, in limiting himself to the study of the rock-masses of a circumscribed area, would never, by the utmost perseverance, in going continually over the same ground, attain to a perfect understanding of the subject of his study. He must go abroad, either in his own person or equivalently, by making himself acquainted with the travels and labours of others. Our knowledge of the ancient conditions and relations of the oldest rock-masses would not be complete if we limited our investigations to those isolated patches in our own country, which,. however important, are still only a part of that great whole, more important traces of which are to be met in regions far away. Thus those very old—indeed, primitive sedimentary rocks, represented in the British Isles in a fragmentary manner, as by the younger or bedded gneiss of the Scottish Highlands, assume in Canada and the Arctic regions proportions of great extent, and consequently, of far greater value. Far back in the obscurity of the past, as must be placed the birth-time of these primitive land-masses, we seem, in our first investigations, plunged in interminable ignorance, like the explorers of some vast subterranean cave in impenetrable darkness. We leave the clear evidences of phenomena around us, as we leave the bright sunshine and the miles and miles of gilded landscape vivid through the transparent air. All is blank, void ; we know not where to tread ; the eye is strained in its efforts to peer through the obscurity until it begins to detect, one after another, the slender threads of light that, peering in through the cracks and fissures of the roof and walls, are faintly reflected from objects around, and in the end we gain a comprehension of the form and grandeur of the cavity.

But the evidence of the primitive lands is not in hopeless obscurity ; there may, indeed, be dark and intricate passages, but the broad light of Heaven shines on a great deal, and in the mountain-ranges of the world, often stand out, bold and high, the memorial pinnacles of the first dry land. There is nothing, in reality, to prevent us, by labour and perseverance, obtaining a just and accurate conception of the earliest stage of the terrestrial and aqueous conditions of our planet, at or before the first traces of that succession of animal and vegetable life, which, repeatedly adapted to its ever varying states, has descended through numerous modifications to our own days.

We have learned, already, to distinguish the granites of various ages, from primeval to tertiary, from each other ; and we have now learned to assort the older or unbedded gneiss, from the younger or bedded gneiss—the former a portion of the first world, the latter the old regenerated sediments of its shores. But it is only over very small areas that this determination—which only requires time and labour to complete for the whole—has been effected. We can accomplish this for England and North America; we might do it for Europe and South America; but for the great tracts of Asia and Africa it would be, as yet, impracticable. Still we have learned enough to know that the present great ridges and mountain-chains of our continental lands are generally the same ridges that first rose above the primeval sea, and that, if repeated have been the depressions and elevations of our continents, those depressions and elevations have been chiefly along the same lines of fracture and of weakness from primeval times to our own. We have learned enough to know that those first lands were less extensive than those broad tracts around us, and lower; that, from beneath an unbounded sea, wrapping the globe as in a mantle, the first granitic and gneissic bosses rose as broad low islands from which the wild waves, beating upon and wearing them down derived and deposited on the more sheltered coasts the vast thicknesses of gneissic mud, primeval conglomerate, and those sediments which are now the "bottom-rocks." With the continued rise of these island-crowns and ridges, the first sediments were also, in time, gradually raised, and the shores became broader and shallower with the expansion of the uprising tracts, until the period of those wide-spreading mud-shores on which the Silurian molluscs and "creeping things" lived in myriad-shoals. Thus, in the first age, the division of the waters which covered the globe into our present oceans and seas was shadowed out, and thus, as the ever accumulating sediments, band after band, spread wider and wider through successive geological periods around island-lands and ridges, at length the *débris* of the land gained its conquest over the restless waters by linking those accumulations together.

As age after age passed away, bands upon bands of sediments widened the extent of earth-surface, and by gradual elevation the oldest land rose into higher tracts, the drainage of which, by a similar gradual progress of events, gave rise to those rivers whose positions and directions are noted by their *debris* through formation after formation of stratified deposits, until some of those grand results—often those of time and slow processes, sometimes those of violence—cut their traces off from the succession of events, and created in particular groups of rocks or in special regions, that kind of hiatus which has been viewed, somewhat too generally, as the effect of cataclysms and catastrophes only. Some of the most important of these breaks have been taken, and properly so, as the divisional marks of the rock-masses in the precise, but arbitrary arrangement and classification into which it is always necessary to bring the objects of every science.

It was amongst these so-called Azoic, or Hypozoic rocks, that clay-slate, mica-schist, hornblende-schist, gneiss, primary limestone, various rocks included in the unmeaning term Grauwacke, and numerous metamorphosed rocks were, by early geologists, and indeed only a few years since, jumbled confusedly together. Many of them have since been proved to be merely altered deposits of Silurian, or even much more recent age.

We have now, however, already began to sort and to arrange, to study and to teach that which when complete, will be the grandest and most interesting of all the lessons of Geology.

This great accumulation of rocks, then, with which we have to deal in this chapter, those between the Silurian formation and the crystalline and unstratified fundamental granites and gneiss, has already been divided by the American geologists, as by our own, into two groups; the one containing no organic remains, as far as our present researches show, the other containing traces of primitive forms of organized beings.

(*To be continued.*)

ON THE OCCURRENCE OF THE BOULDER CLAY, OR NORTHERN CLAY DRIFT, AT BRICKET WOOD, NEAR WATFORD.

By Joseph Prestwich, Esq., F.R.S.

The Boulder Clay is so seldom exposed in the neighbourhood of London, that I think it may be desirable to point out a new locality where I have met with it and where it may yet be seen, especially as I have just found some points, connected with its position at this place, which are of rare occurrence. The new line of railway from Watford to St. Albans passes chiefly through gravel and chalk. At one place, however, called Bricket Wood, about midway between those towns, there is a cutting of some length, and twenty to thirty feet deep, entirely through the Boulder Clay. The superposition of this clay, with regard to the gravels of the London district, is seldom to be determined; the cutting itself throws no light on this subject, or, at least, nothing very definite. But a ballast pit has recently been opened at the Watford end of the Bricket Wood cutting, and immediately south of the line, which exposes a section of much interest. The Boulder Clay has there almost thinned out, leaving but a seam one to two feet thick, whilst both above and below it is a thick bed of gravel. The lower sandy gravel, which consists chiefly of sub-angular flints and flint pebbles, with some quartz, sandstone, and old-rock pebbles, with subordinate seams of whitish sand, has a clean, washed appearance. The upper gravel consists of very similar sub-angular materials, but is less sandy and darker in colour, arising apparently from the admixture of clay derived from the wearing down of the Boulder Clay. The upper gravel seems to be of limited extent, but the lower gravel I believe to pass under the Boulder Clay, for there is an old pit of the same gravel near the brook on the north side of Bricket Wood, towards the Watford end. There is no Boulder Clay in this other pit, but the gravel presents the peculiarity of being concreted in places into large brecciated and sandy masses by a calcareous cement. In this pit I found no organic remains; but in the ballast pit I was fortunate enough to discover, in the lower gravel, a few pieces (but not sufficient to determine the species) of the tooth and tusk of an elephant. A workman, whom I afterwards spoke to on the common, told me he had found several bones in the lower part of the gravel, but none of them had been preserved. The lower gravel reposes upon an irregular surface of chalk, which is exposed at places at the bottom of the pit, which is now no longer worked and may, I understand, possibly soon be levelled. It is well worth a visit, and a longer search than I have been able to give. There is a station at Bricket Wood, but it is at the St. Alban's end of the wood, at a considerable distance from this cutting.

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Novel Production of Artificial Coal and Anthracite (continued)—Metamorphism—Action of Lava and Trap-rocks on Calcareous Strata—Production of Minerals by Metamorphic Action—Metamorphosed Gypsum—Red-hot Lava two years and a half old—Cotunnite and Kerasine—Origin of Crystallized Sulphur in Sicily—Formation of Prairies—Their Relation to Peat-bogs.

M. Cagniard de la Tour formerly submitted woody matter in closed vessels to the action of great heat, with a view of obtaining coal; but his experiments, like those of Hutton, failed—the only result was bitumen. M. Barouilier, repeating the experiments of Hutton and Cagniard de la Tour, introduced three important modifications, which have contributed to the success of the operation. Firstly, he interposes a stratum of woody matter between layers of clay; in the next place, the vessel is not completely closed, but so arranged that the steam, and disengaged carburets of hydrogen, remain a certain time in contact with the mixture of ligneous matter and clay; and, finally, the temperature to which his apparatus was submitted never exceeded 300 degrees (Centigrade). The consequence was, that the products obtained resembled coal in every respect; and, as we said before, their appearance varies according to the nature of the wood employed in the experiment. They vary, also, a little with the temperature.

In a former paper we alluded to some very ingenious experiments made by M. Daubrée, the eminent geologist of the Faculty of Sciences at Strasburg,* by which he produced, artificially, a number of well-known minerals, by the sole action of water at a high temperature, sustained for long periods of time. In a Memoir lately published,† the same author states that, by submitting pieces of pine-wood to this remarkable action of hot water or steam, in a closed tube, he has obtained *Anthracite.* This is another new and curious fact to be added to his former interesting discoveries concerning the origin of minerals.

In a previous article‡ we have alluded to some interesting observations of M. Delesse on the metamorphism of rocks, and have made known the results of his researches on the alteration of combustibles—such as lignite, coal, anthracite, &c.—by the action of eruptive or plutonic rocks. We are happy to say that this distinguished geologist perseveres in the study of metamorphism, upon the phenomena of which he has already thrown so much light. In one of his recent memoirs, he has reviewed the action produced by lava and trap-rocks on the different limestone strata with which they have come in contact.

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* See the Geologist for Feb., 1858.

† *Sur le Metamorphisme, &c., par* M. Daubrée. *Paris, Victor Dalmont,* 1858.

‡ The Geologist for March, 1858.

In the case of lava, either ancient or modern, the metamorphism produced seems to be entirely the result of great heat. By contact with lava, limestone has become crystalline, and has taken a saccharoid appearance. A great number of minerals are also formed in limestone strata by the metamorphic action of lava. M. Delesse has remarked, in particular, garnets, idocrase, epidote, pyroxene, and mica, all of which are observed at Vesuvius in the limestone of La Somma. Many stratified rocks with which lava has come in contact have been split or fissured, and have taken a reddish tint, which they had not before. This coloration, which is pretty general, appears to us to be due to the action of the atmosphere upon the protoxide of iron contained in the rocks at the time of their contact. This protoxide generally produces green or black-coloured silicates in volcanic and other plutonic rocks; but, if these are violently heated in the air, a certain quantity of the protoxides contained in their silicates of iron is transformed into peroxide, which is red.

When the heat produced during the eruption of the lava has been very great, the rocky strata upon which it has acted have become partially or wholly vitrified. It has been remarked, however, that rocks, sandstones, &c., are *not* changed into transparent quartz by the metamorphic action of lava; on the contrary, their silica combines with the different oxides furnished by the latter, and thus are produced certain silicates which have a vitreous appearance, thereby resembling quartz of a cellular structure.

The metamorphic action of trap-rocks—among which M. Delesse mentions basalt, dolerite, hyperite, euphotide, diorite, and ordinary trap—is observed to have been more marked on calcareous strata in those parts where the erupted mass has been greatest. The change undergone by the limestone-rock rarely extends, however, to more than a couple of yards from the sides of the erupted trap-rock. In general, this change has been greatest where basalt and dolerite have been ejected. The metamorphism undergone by limestone, in these circumstances, includes a change of structure and the formation of certain minerals. Some calcareous strata have become hard and compact in those parts which have been pushed up by trap-rocks ; others have taken a fragmentary, or even a prismatic structure—but only when they are argillaceous or siliceous. The prisms thus formed in limestones are not so well defined as those we observe in other varieties of rocks ; for instance, in sandstones, &c. The limestone of the Pyrenees has become cavernous or cellular by the metamorphic action of diorite. "Limestone," says M. Delesse, "generally becomes crystalline by metamorphism ; its colour becomes paler, and often exceedingly white." This reminds us that, some time ago, we found that certain limestones, which were remarkable for their whiteness, and which had been modified in structure by metamorphism, contained a notable quantity of magnesia, which must perhaps be attributed to the contact of the eruptive rock. The analysis, made at the same time, of a greenish-yellow compact dolomite gave me protoxide of iron and magnesia, besides lime, in such proportion that a certain quantity of protoxide of iron seems to have been substituted for an equivalent quantity of magnesia.

When a trap-rock has exercised metamorphic action upon a stratum of limestone, M. Delesse observes that the density of the latter has augmented considerably ; and in the vicinity of the eruptive rock are found mineral species produced by its influence, amongst others, oxide of iron, oxide of manganese, magnetic pyrites, brucite, dolomite, calcareous spar, chlorite, pyroxene, garnet, idocrase, gehlenite, &c. We find, also, in veins, injected, as it were, through the limestone, barytine, celestine, oligiste, pyrites, galena, blende, copper-pyrites, and some others.

M. Delesse has observed, also, that gypsum has been acted upon by metamorphism much in the same way as limestone ; thus, it has been observed in some cases to have become crystalline, and to contain oligiste and even iron-glance (carbonate of iron). We will reserve for a future paper M. Delesse's remarks on the metamorphism of sandstones and argillaceous rocks.

Professor Scacchi, of Naples, has lately addressed a letter to the

French geologist, M. Ch. St. Claire Deville, of which we reproduce the following extract:—"I don't know whether you are already aware that the lava of Vesuvius, which ran into the *Fosso della Vetrana* in 1855, was still, here and there, in an incandescent state as late as last autumn, and also that this lava has produced, by sublimation, a notable quantity (*non piccola quantita*) of *Cotunnite* (chloride of lead), of which I send you some samples, as this substance has been very rare here since 1822."

M. Deville remarks that these few lines are well worthy of notice, for it is certainly a curious fact that the lava which accumulated thickly in *la Vetrana* should preserve, two years and a-half after its emission, enough heat to present, here and there, portions in an incandescent state. But the presence of *cotunnite*, as a production of this lava, is not less remarkable. Our readers must not confound this rare mineral species with the chloride of lead called *Kerasine*, formerly discovered in the Mendip Hills of Somersetshire, and analysed by Berzelius, who found it contained one atom of chloride, and two atoms of oxide, of lead. According to M. Ch. Deville, *cotunnite* has only been seen at Vesuvius on three different occasions, and each time shortly after some great eruption or marked activity of the volcano. It was first observed in 1822, shortly after the great eruption of that period, and described by Monticelli and Covelli as a new mineral species; it was discovered in the higher crater of the volcano. It was next seen in 1840, a short time after the great eruption of 1839, when Signor Scacchi also discovered this same mineral in the upper crater of Vesuvius, near the *Punta del Mauro*. Finally, in 1857, the last-named geologist remarked the presence of *cotunnite* in the lava emitted a few months before the time of his observation.

We have received lately from Sicily a fine sample of crystallized sulphur, from the secondary strata of that island. We were astonished, on examining this sulphur, to find with what certainty we are able to arrive at its geological origin by reasoning from established chemical facts. Some months ago, M. Berthelot, one of the most distinguished chemists in Paris, showed that the metalloid of which we speak manifests two distinct forms: 1st, electro-negative sulphur, soluble in many dissolvents, but principally in sulphide of carbon, and crystallising in octahedrons; he has also called this variety "Octahedral sulphur." 2nd, electro-positive, or amorphous sulphur, insoluble in sulphate of carbon, and non-crystalline. The sulphur of the first category is that extracted from combinations in which sulphur enters as the electro-negative element, as in sulphuretted hydrogen and the different metallic sulphides. That of the second category is extracted from combinations in which it forms, on the contrary, the electro-positive element, as in sulphureous acid, sulphuric acid, and their salts, &c.

The sulphur we received from Sicily is in large transparent crystals belonging to the third crystalline system, having for type the prism with a rectangular basis, or, as the French crystallographers term it, *le système prismatique rectangulaire droit*. It therefore is identical with M. Berthelot's octahedral or electro-negative sulphur; and, to assure myself of this, I treated it with sulphide of carbon, and found that it was completely soluble in this liquid, leaving not the slightest residuum. These natural crystals are, moreover, very beautiful, being of a transparent yellow colour, and showing, here and there, in their superficies or in their interior, the colours of the rainbow.

It appears evident enough, from what we have just stated, 1st, that this Sicilian sulphur has been crystallized in nature from a solution and not by fusion—for sulphur, when crystallized by fusion, takes the form of long prismatic needles belonging to another (the 5th) crystalline system (*système prismatique oblique*); its origin cannot, therefore, be immediately attributed to volcanic eruption. 2ndly, that if this sulphur be owing to the decomposition of any soluble combinations in which this element enters, it must evidently have come from such as contain it as an electro-negative element. For instance, from sulphuretted hydrogen, or certain metallic sulphides, and not from sulphurous acid, from sulphuric acid, or their salts.

M. Lesquéreux has read before the *Société de Neufchatel* a paper on the formation of prairies in America, which concerns at once botanical geography and geology. The problem which the author has just endeavoured to solve, namely, the cause of the formation of these vast American prairies, is as interesting to the geologist as to the botanist, and, on this account, we will expose here the facts contained in M. Lesquéreux's memoir, which we consider most worthy of notice.

In nature, forests and prairies are not often met with simultaneously or intermingled one with the other, even on large portions of territory; on the contrary, they are seen to stretch *separately* over vast tracts of land. It has been remarked that the shade of trees prevents the growth of plants belonging to the family of the grasses, whilst the latter, in their turn, hinder the developement of the seeds of trees, and leave the young shoots exposed to a variety of accidents. But why and how have these vast tracts of country become forests and prairies at some very ancient period—probably when the waters retired from the surface of the soil which they cover, and vegetation first sprang up there? M. Lesquéreux asked himself this question whilst rambling over the plains of North America, and he endeavoured to answer it by direct observation.

On the banks of the Mississippi and the Minnesota M. Lesquéreux has actually seen prairies in process of formation. According to his observations, this is what takes place :—Mud is constantly deposited at each side of the river, but when the latter swells in the rainy seasons, the water passes over its banks, and forms immense marshes or swamps, where it becomes stagnant and putrid, and where the sand and mud which it has washed along in its course are deposited. Nothing is less favourable or contrary to arborescent vegetation ; the roots are deprived of air by a stratum of water, which is never renewed ; trees, if they have already begun to grow in these situations, perish when such inundation occurs, and when the heat of a summer's sun has evaporated the water, grass, rushes, and a few other plants of like structure, can alone resist and accomplish their developement under such circumstances.

In Germany, and many other parts of Europe, marshes are rarely, if ever, dried up in this way—the heat of the summer's sun is not sufficient in this climate to effect a complete evaporation before the equinoctial rains begin—they persist as swamps, and, in course of time, by the accumulation of *Sphagnum* and *Conferva*, peat-bogs are formed. Ancient marshes or swamps become either prairies or peat-beds, according to circumstances, but more especially according as inundation has been followed by a longer or shorter period of dryness. As regards America, M. Lequéreux brings forward a great number of examples, mostly taken from the banks of the great lakes Erie and Michigan, or the neighbouring rivers, to prove that prairies formed at different periods owe their existence to the causes above-named ; whilst forests appear to have been formed solely on hills, or in parts remote from the influences of periodical inundation.

(To be continued.)

GEOLOGICAL MANIPULATIONS.

ON THE PREPARATION OF CLAYS, SANDS, AND CHALK, FOR MICROSCOPICAL PURPOSES.

By T. Rupert Jones, Esq., F.G.S.

To obtain microzoa from Gault, London, Specton, Kimmeridge, Oxford, Lias, and other clays, pieces of the clay, well dried in the sunshine or in an oven, should be placed in a glazed pot or pipkin, and covered with boiling-hot water. The clay will fall more or less completely into a muddy mass, which must be worked up with the water by the hands into a nearly uniform creamy consistence, and the thinner supernatant fluid then poured off. This process will be completed only by several repeated waterings, kneadings, and off-pourings; together with occasionally the drying of the undissolved portions of the clay, and again subjecting them to the hot-water process and repeated manipulation, until a small quantity only of sandy clay remains. This, after having been dried, should be boiled in water either in a flask over a lamp or gas-light, or in a small saucepan on a fire for an hour or more, when, the muddy water having been poured away, the residue will be probably sand, fragments of shells, and numerous small foraminifera, with perhaps bryozoa and entomostraca.

Some fossiliferous deposits, such as the Bracklesham sands and clays, the Barton shelly clays, the Crag, the Calcaire Grossier of Paris, the Falunian beds of Bordeaux, &c., fall readily into a loose state in water, sometimes even without much stirring. In this case, the supernatant water should be poured through muslin or a fine sieve, that the small foraminifera should not be lost. In clays, these minute shells are generally filled with the matrix; but in sandy beds they often remain empty, and therefore float in the water. The discoloured and muddy water having been repeatedly poured off from the washed sand (whether the sand be siliceous or calcareous, in the latter case being probably the detritus of shells or bryozoa), the residue should be dried, and then sifted into various degrees of fineness for convenience of picking.

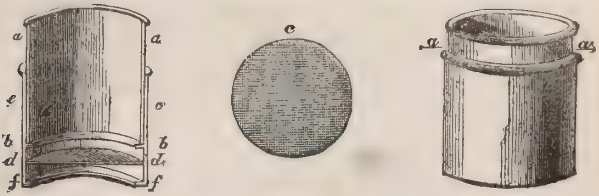

Fig. 1. Fig. 2. Fig. 3.

A, *a*, internal cylinder, with *b*, *b*, in-turned rim; *c*, perforated zinc plate or sieve; *d*, *d*, half of perorated plate *c*; *e*, *e*, outer cylinder; *f*, *f*, in-turned rim.

It is sometimes more convenient to sift the washed materials whilst in the wet state, and to dry the several siftings in succession on a stove or in an oven. In this case, a metallic sieve, constructed so as to allow of the use of several moveable bottoms of perforated zinc, of different degrees of fineness, is required. (See figures.) This sieve may be of block-tin or zinc, the latter is preferable. The best consists of two cylinders about three inches across, and rather more high, one fitting within the other *(a* and *e)*; each having its lower edge in-turned for about an eighth of an inch *(b* and *f)*, so that, by pressing down the internal cylinder, a circular plate of perforated zinc *(c* and *d)*, made to fit the interior of the larger cylinder, is firmly held between the bottom rims of the two cylinders. There should be seven or eight perforated plates of different degrees of fineness; such sieves may be obtained of Mr. Snow, zinc-worker, 50 Millbank-street, Westminster, at a cost of 3s. each. In using the sieve, especially in wet siftings, care should be taken to keep the apparatus wiped clean and dry, so that none of the fine particles of the different materials should become mixed with each other; and special attention is required to prevent the fine sand getting between the two cylinders, which would render it very difficult to separate them.

The muds and sands obtained by dredgings and soundings, as well as clays, &c., brought up by the anchor, may be prepared in a manner similar to that recommended for the manipulation of other clays.

Picked specimens from clays and sands may be sometimes further cleaned by being boiled in a weak solution of potash, in the proportion of about one part of *liquor potassæ*, with nineteen parts of water, or more of the potash if required, according to the coarseness and foulness of the specimens, up to one part in four, in a flask over a spirit or gas-lamp for ten minutes or more.

To prepare chalk for microscopical examination, if only small quantities are to be treated, the best plan is to select a piece of soft white chalk,—that which has been kept some time in a cabinet is most easily worked, especially chalk from the interior of an Ananchyte or Galerite, and to wash it with a moderately soft nail-brush in a hand-basin half full of water, keeping the chalk and brush just under the surface, so that the loosened particles should all fall in the water. To prevent the chalk from being worn into longitudinal furrows, the part under the brush should be constantly moved round. It should also be looked at occasionally with a hand-magnifier, so that any larger specimens of bryozoa and foraminifera may not be destroyed by rough brushing, but be more carefully picked out with a needle or penknife, or separated by the careful use of the brush. When a sufficient quantity has been brushed down, the water should be stirred and the chalky portion poured away, or water may be allowed to run into and overflow the basin, until the water remains clear over the sediment. The latter should then be placed in a round-bottomed tea-cup or gallipot, and rubbed gently with the finger in water, until, by further washing, some more of the chalk has been removed, when the residue should be carefully dried in an oven, or otherwise, without the least disturbance. When dry it may be sifted and picked; but if it be still "chalky," further manipulation by gentle rubbing in water will be necessary, especially if the chalk-dust has been put by for some time after having been prepared. On a larger scale, chalk may be prepared by being broken up in a mortar, or roughly ground with a brick, stone, or roller, on a pavement, and then washed in water, the larger fragments being excepted.

In many localities the chalk and chalk-marl present, especially along the foot of the chalk-downs, and at the base of chalk-cliffs, a natural detritus, which, by careful manipulation, is found to yield rich harvests of microzoa. My friend, Mr. Harris, F.G.S., of Charing, Kent, has for some years availed himself of the abundant store of foraminifera and other minute fossils which he finds in the argillaceous "chalk-detritus," or, more properly speaking, decomposed chalk-marl of his neighbourhood; and the plan that he has lately pursued in obtaining these pretty objects free from their tenacious matrix, is as follows:—The "detritus," having been dug up, is exposed for a time to the air, and then portions are placed for some days in a trough of water until they become soft; small quantities are next put, with a large proportion of water, into a small harvest-barrel, which is then carefully closed with a bung-cork, and the outside of which is armed with bucket-flanges, as in the case of an ordinary overshot mill-wheel. Making use, as a motive power, of a little stream running through his meadow, and suspending the barrel on pivots against a miniature weir, Mr. Harris secures the constant revolution of the barrel, and consequently a continual churning process, which reduces the detritus in the barrel to a creamy consistence. The contents of the barrel are then poured into a long conical canvas bag, which is set in the stream, and by the natural flow of the water and a continued dipping, by aid of its handle, gradually loses the finer chalky material and retains a coarse sediment. Care is taken to keep the mouth of the bag about the surface of the water; otherwise some of the more valuable sediment would be washed out by the regurgitating current and lost. The residue is taken into the house, dried, sifted, and picked.

Sometimes it is found advisable to subject some portions of the siftings, or of the picked specimens, to a further churning in a small bottle of water affixed to the outside of the water-wheel.

GEOLOGICAL DESIDERATA.

BRITISH LOCALITIES OF FOSSIL MAMMALIA.

THE EDITOR, in opening this department of the magazine, earnestly asks the assistance of every true geologist. In the provinces, geologists must be the gatherers of materials which those resident in large cities, from the association with the chief talent of the day, and from their ready access to large collections of specimens, books, and other essential aids, are placed in the best position to interpret. The generalizer in geological matters cannot be, to any great extent, the worker in the field; and the Editor trusts that his magazine may be the link to associate the labours of all who are interested in the progress of Geology. No one, in forwarding information on such points of inquiry as from time to time will appear in this department, need hesitate on the ground of any fancied inability, or on a supposition that the information might have been conveyed by others. It will be far better for us to receive it in any form, or twice over, than not at all. The information which we receive we shall tabulate or condense every three months, or at such other periods as may be deemed most advantageous.

The correspondence in full we shall hold at the service of the geologist seeking the information from our readers and correspondents. We think it cannot but be apparent at all, how much real work is to be done by the means we are now proposing, and we trust our attempt will be well and promptly supported. The importance of the subject of Mr. Prestwich's letter will, without doubt, secure that cordial co-operation of provincial geologists which it richly merits.

To the Editor of the Geologist.

Sir,—Amongst the many interesting problems we have to investigate, and that are, now in particular, attracting the attention of geologists, is that which relates to the character of the fauna inhabiting this land during some of the later geological periods. Those only who have worked at this subject can form any idea of the vast number of elephants, rhinoceroses, oxen, deer, &c., which must, at more than one period, have flourished in this country on surfaces now buried beneath drift and gravel. Occasionally their bones are met with in very large quantities, but their distribution is very irregular and uncertain. The fact of their occurrence, however, frequently remains unknown beyond the place where the discovery is made, and the knowledge of such facts is too often lost or forgotten for want of a convenient and ready record.* Your pages could afford, Sir, exactly the facilities required. Thus it would be of great use, and I, for my own part, should feel particularly obliged if any of your correspondents in different parts of the country could furnish us with information on this point. I would confine myself more especially to the occurrence of the bones of elephants (the teeth and tusks being so easily recognised), although, at the same time, any information respecting the bones of other animals would be very acceptable; and I would ask for a mention of their occurrence—naming place, character of deposit, depth beneath the surface, position—whether in valley or on hill—&c. Such information you might tabulate monthly or quarterly, mentioning the authority. Or what would form a still more valuable record would be, that resident correspondents should each take a county and give a list of places where such remains are or have been found. We particularly require information in this respect with reference to Northumberland, Lancashire, Cumberland, Cheshire, and other northern counties, although in the more southern counties the same particulars are, also, in many cases equally required. An additional interest now attaches to this subject, from the circumstance that there are indications of each different stage of this Pleistocene period having been marked by different species of elephant, &c. If these species can be distinguished by the aid of Dr. Falconer's forthcoming paper in the "Quarterly Journal of the Geological Society," the information furnished will be the more valuable.—I am, Sir, yours truly,

Joseph Prestwich.

10 Kent Terrace, 11th May, 1858.

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* There is a case in point in another communication I have sent you. In that instance I happened to visit a gravel-pit, opened only temporarily, and find remains of elephants, of which no record would have been preserved but for my chance visit.

NOTES AND QUERIES.

British Fossils and Geological Manipulations.—To the Editor of the Geologist. "Sir,—In perusing your article upon "The Common Fossils of the British Rocks," in the numbers of the Geologist, an idea struck me, that it would be of very great assistance to all beginners in the science, like myself, if, in describing the various strata, engraved figures of all the genera and species discovered up to the present time were inserted, which are now only to be found in books of an expensive character. If this were done, beginners would very much more readily determine their specimens, as well as be able to identify the strata to which they belong; thus facilitating them in comparing the specimens which they may have collected with those in the British and Jermyn-street Museums, and saving their time, which to those who are not in very ample circumstances, is extremely valuable. I also think that a few concise observations upon collecting and arranging would likewise be of great service, embracing the most useful forms of hammers, the easiest way of extracting fossils from the matrix with which they may be encumbered, &c. Amator Naturæ."—It has been, from the commencement of his article on Common Fossils, the intention of the Editor to give illustrations of all the common British fossils, with explicit descriptions of their nature, character, and order of classification; as also to draw, wherever practicable, comparisons with existing forms. It was necessary, however, before doing this, to popularize the general subject of geological doctrines concerning the formation of rock-masses and the sequence of geological events. The Editor's articles deal more especially with the *common* fossils; "the gems of private collections" will include the rarer specimens, so that by means of these two series both the man of science and the student will be furnished with accurate figures of at least most, if not all, our British fossils. Arrangements have already been made for articles upon such useful topics as those suggested by our correspondent in the latter part of his letter. One of these, with which we have been kindly favoured by Mr. T. Rupert Jones, is printed in this number; and will be followed, from time to time, by others of a like practical character. We are obliged, at all times, for such suggestions, as they enable us the more fully to provide for the wants of our readers.

Vegetable Remains in the Permian of the South of Shropshire, &c. By Mr. C. E. Roberts, Kidderminster.—"The low hills which skirt the Severn at Alveley, six miles south of Bridgnorth, composed of a Permian siliceous grit, locally called 'Grindstones,'* have yielded me some badly-preserved vegetable remains, which are, as far as I can read them, leaves of Cycadaceæ, possibly *Nœggerathia*. These are worth noting, as being the first fossils detected in the beds of this system, exposed in this district.

I have just obtained a *Ptilodictya* from the mountain-limestone of Farlow, which I cannot quite make out. In form and linear arrangement of cells it approaches near to *P. costellata*, M'Coy, but the inter-cellular spaces are pitted in the line of the rows with very minute oval cells, alternating one and two in number. I have several specimens on a slab, with *Ptilodictya acuta* and *Fenestella patula*, M'Coy. Their state of preservation is exquisite. I have made out the 'flat internal axis' in one specimen, as noticed in M'Coy's description of P. costellata, Contrib. Brit. Pal. p. 174."

Potato-stones, — Mercury.—"Sir,—The 'potato-stones' are found in the dolomitic conglomerate, at a spot where that rock dies out. They often contain pieces of carbonate of lime in the centre, which may, perhaps, have been derived from the Mountain-limestone, which is but a few yards distant from the spot where the potato-stones are found. Since reading in the April number of the

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See "Silurian System," pl. 30, fig. 4.

GEOLOGIST the account of the discovery of mercury in the soil at Montpellier and Lyons, a somewhat similar discovery has come under my notice. Whilst the workmen were effecting some alterations, a few years ago, at the Friends' Meeting House, in Bristol, which was formerly a monastery, a considerable quantity of mercury was found in the old sewers of the building; a lump of this metal, weighing about a pound, is now in the possession of a friend of mine. Yours, &c., **FRANK DYMOND**, 2 Victoria Villas, Weston-super-Mare."

PRIVATE COLLECTIONS. — "DEAR SIR, — It seems to me that if private individuals, who have geological collections, would make this known in your journal, stating where they reside, and expressing their willingness to show the contents of their cabinets to any geologists who might happen to be in their respective neighbourhoods, they would be conferring a benefit upon the scientific public, and especially upon beginners. Many excellent private museums, large and small, are, from such want of publicity, scarcely known and rarely visited, and so far they are virtually lost for scientific purposes. Feeling this so much in my own case, I take this opportunity of saying that I shall be, at all times, happy to show my extensive general collection to any brother geologist, and to give him any hints respecting the geology of this district. I should also, occasionally, be willing to make exchanges under suitable conditions. I may also add that there is an excellent Geological Museum at Warwick, containing the finest collection of New Red Sandstone fossils in the kingdom, besides many other objects of interest. Faithfully yours, P. B. BRODIE, Rowington Vicarage, near Warwick."

INSECTS AND SEEDS IN PEAT AT STANWAY.—"SIR,—In a bed of peaty matter, in which I have recently found most interesting remains, viz., tusks, teeth, and bones of the elephant and rhinoceros, there also appears much other organic matter, namely, the elytra of insects, seeds, &c. To recognize and name these requires the skill of one well versed in those departments of natural history, with which, unfortunately, I am not acquainted. I shall esteem it a great favour if you will have the goodness to inform me where I could obtain assistance in getting this much-desired information, and you will much oblige, JOHN BROWN, Stanway."

GEOLOGICAL INSTRUMENTS.—"SIR,—Would it come within the scope of your publication to give a practical example or two on the modes of ascertaining the height of cliffs, quarries, hills, &c., and the method of using the clinometer and aneroid barometer; or, if this could not conveniently be done, to furnish information as to the books in which those and similar matters of practical geology are most clearly and intelligibly described? Your aid would be acceptable to one, at least, and possibly to most of your subscribers. Since writing the first part of my letter, I notice, at page 210, a query very similar to my own, so that I think a little information on the above heads would be pretty generally valued.—J. A. F." Maidstone.—One of the new departments we open in this number is that of Geological Manipulations. In the series of articles which will thus appear from time to time, information on barometric measurements, geological surveying, preparation of microscopic objects, &c., will be included. The numerous letters we have received on this point show how much such information is needed, and how highly it would be prized. Whenever a real want like this is made known to us by geologists, we shall always use our best exertions to give the required assistance. In the meantime, we refer our correspondents to the information on this subject contained in the last chapter of Professor Phillips' late edition of his "Manual of Geology."

THE MOVEMENT BY ICE OF THE CULLODEN MARCH-STONE.—"Being edified and much gratified by hearing a discussion on abrasure in rocks, occasioned by the supposed slipping of boulders and glaciers, brought forward by Professor Ramsay in a paper read by him at the meeting of the Geological Society, on Wednesday evening, the 12th ult., and commented upon by Sir Charles Lyell, Professor Phillips, and Mr. Morris, it occurs to me that it will be instructive to put on record in your interesting periodical a circumstance corroborative of the views taken by the learned speakers on that occasion, which happened, I think, in 1817, near my native town, Inverness. That town, surrounded at short distances by table-lands and lofty mountains, is picturesquely situated at the head of the Murray Firth, on the banks of the river Ness, which there, in conjunction with the river Beauly, runs into the Firth. The waters of Loch Ness, from which the river takes its rise, are remarkable for never having been frozen in the most severe winters: the reason assigned being the largeness of the body of water in that lake, having an extent of twenty-four miles in length, a mile and upwards in width, and in many parts being more than eighty fathoms deep. The great depth is, without doubt, the sole cause; as there is nothing peculiar in the water itself, which, it is well known, when taken from the river, congeals as soon as any other water. About two miles from the mouth of the river, in an estuary of the sea, and part of the Murray Firth, a large boulder-stone, of three or four tons weight, was imbedded in the sand of a clear beach, extending from the shore, at low water, for nearly a quarter of a mile. This boulder-stone was considered the "March-stone," or western boundary of the property of Culloden, and was within two miles of the field of the memorable battle of Prince Charles. In the spring of 1817, a severe frost occurred, which lasted some days; and on that occasion this estuary was covered with ice, which, during the several tides, attained sufficient thickness to fairly raise the Culloden "March-stone" from its bed in the sand; when, a sudden thaw setting in, with a strong south-easterly wind, the stone was floated, at high tide, from its resting-place, and carried upwards of two hundred yards, leaving, in its progress seawards, a deep marking in the sand, towards the north-west This event took place in the morning, and a very large concourse of the inhabitants of Inverness went to see the stone in its new position, and to observe the original site, and the track of the stone's passage over the sand made during its transit. An event of this sort, in former times, would probably have been attributed to the nocturnal labours of the fairies. It appears to me to be a fact quite worthy of being recorded as a geological phenomenon.—JOHN JAMESON, Arlington Square."

GEOLOGY OF ASHBY-DE-LA-ZOUCH.—"Could you kindly inform me, through the medium of your excellent magazine, the GEOLOGIST, if I can find any fossils near Ashby-de-la-Zouch. If there are any what are the characteristic species? and where should I be likely to find them?—M. S."—Ashby-de-la-Zouch, we need scarcely say, is on the coal-measures. On this district, in 1831, Mr. Edward Mammatt wrote his interesting book, entitled "Collection of Geological Facts and Practical Observations on the Ashby Coal-field, in the Parish of Ashby-de-la-Zouch and the Neighbouring District," 4to. This book is illustrated by a map, sections, and by numerous plates of the fossil remains of plants found in the coal-shales of the neighbourhood. Shells should also be searched for in these shales, and minute entromostraca, such as Cyprides, &c., are to be found. The Millstone-grit, coming out beneath the coal to the north-east of Ashby, may also be examined for fossil plants. The red sandstones and marls surrounding this coal-field appear to be unfossiliferous. The Syenites protruding through the schists of Mount Sorrel afford many interesting geological lessons, as may be found in Mr. Jukes' "Geology of Charnwood Forest," printed in the appendix of Potter's "History and Antiquities of Charnwood Forest," 4to., 1842. At the end of the second volume of Mantell's "Medals of Creation," a sketch is given of a geological trip to this part of Leicestershire. The geological features of the Charnwood district are laid down in sheet No. 63 of the National Geological Survey map.

GEOLOGY OF HUDDERSFIELD.—"SIR,—Will you have the kindness to tell me the nearest localities to this place for the following:—Old Red Sandstone, and Old Red Conglomerate; Glacial or Northern Drift; and what Fossils are to be found in it—*i.e.*, in the place referred to; Oolite; Granite; and Trap-rocks. I should also be very glad of a description of the Brown-coal of Germany, spoken of by Lyell; *i.e.*, what is the thickness of the seam, whether it is lignite only, or is partly bituminous,? &c.—Yours &c., S. H., Huddersfield."—The nearest point of Old Red Sandstone occurs near Bridgnorth, on the Severn; Old Red Conglomerate exists beneath the great limestone of Yorkshire, in Riblesdale. We cannot, from personal experience, point to any good section near Huddersfield of the Boulder-drift, which over-runs the North

Eastern and Eastern Counties of England, including Lancashire, Cheshire, and Staffordshire. The nearest body of the Oolite and Lias series would be in the East Riding of Yorkshire, and in the northern part of Lincolnshire. The nearest granites, probably, are Shap Fell, and those near Ravenglass in Westmoreland. Huddersfield is nearly equidistant from the Trap-rocks of Buttermere, Ulleswater, &c., from those of Charnwood Forest, and from those of Wellingtonand the Breidden, on the borders of Wales. The Brown Coal of Germany presents several varieties of lignite, some of it being in the condition of bog-oak, and some almost approaching to glance-coal. There seem to be two main seams of brown-coal over the north of Germany, but for the most part the numerous patches of these lignites spread over Europe are more or less isolated accumulations of vegetable matter in the sediments of the estuaries and lakes of the middle Tertiary period, the upper Eocene of some geologists, the oligocene of Dr. Beyrick, and some of the brown-coals of Southern Germany belong to the upper Tertiary period. A paper, treating of the brown-coal of Germany, read by Mr. Hamilton, was printed in Vol. X. of the Geological Society's Journal.

SEPTARIA OF THE LONDON CLAY.—"SIR,—Could you oblige by informing me, through the medium of your valuable periodical, how those concretions, called by geologists 'septaria,' which are met with so abundantly in the London Clay, came into the position in which we now find them, viz., in such horizontal strata, what is the reason for their peculiar internal structure, of what minerals are they essentially composed, and in what books am I likely to find a full account of the Lower Eocene strata, more especially? Yours, &c.,—AMATOR NATURÆ (Cavendish Square)."—The septaria of the London clay are composed of clay and carbonate of lime, with some silica. Similar concretions have been found to contain as much as 50 per cent. of lime, whilst their clay-matrix contained only about 10 per cent. Dr. Jackson has observed that the crystallizing force of the carbonate of lime is the cause of the concretionary structure and form of such nodules; the foreign bodies frequently found within them having served as nuclei around which this semi-crystallisation took place: the carbonate of lime has segregated and carried with it the inert particles of clay; and their sphæroidal form is that which would result from this action when the force was not adequate to the production of crystals. Subsequently, during the contraction of the nodular mass, crevices were formed, in which carbonate of lime more or less freely crystallized, forming veins or hard divisional plates; hence the name *septarium*. The apparent horizontality of these nodules is owing to the original bedding of the several layers of clay with different proportions of fossil remains, which may have been, to some extent, a source of the carbonate of lime. Mr. Prestwich is the chief English author on the tertiary strata of England. His numerous memoirs have appeared in the "Journal of the Geological Society;" and the small work he has lately published, "The Ground beneath us," contains a concise epitome of his views and deductions; we recommend it for our querist's perusal.

NEW RED CONCRETIONS.—The note of W. R. B., of Stockport, referring to New Red Sandstone specimens from the Mersey, between Egremont and New Brighton, is difficult to answer, as we have none of the specimens before us. Possibly they are ripple-formed layers with argillo-calcareous concretions, the origin of which cannot be determined without actual inspection. Our correspondent's suggestion of their being "mud-balls" may be correct.

WORKS ON THE GEOLOGY OF NORTH STAFFORDSHIRE.—SIR,—I have been much interested by the articles in the GEOLOGIST, on the carboniferous beds; and write to ask if you can recommend any books which give full information as to that formation, especially of the coal-beds themselves? As I have opportunities and facilities for personal inspection of the North Staffordshire coal-field, I shall feel particularly obliged if you can direct me to any books written with special reference to that field. In your last number, I saw a notice of the *Mining Journal*; is the North Staffordshire coal-field, in its geological aspects, noticed in this work, if so, what is its price?—C. F. L. Leek."—We cannot point to any special work on the North Staffordshire coal-field. Professor Jukes has described that of South Staffordshire in minute detail in the "Records of the School of Mines"

(Jermyn-street, London). Nor do we know any work wholly devoted to a description of the Coal-measures of England. Numerous memoirs on the several coal-fields, or portions of them, are to be found in the transactions of Societies, such as those of the Geological Society, the Northumberland Philosophical Society, the British Association, &c. Professor Phillips' "Manual of Geology" contains much information on the coal-fields; and references will be found to numerous special works on the subject in the chapter on Coal in the last edition of Mantell's "Wonders of Geology." Sheets No. 62 and 72 of the Government Geological Survey contain the geological features of the Staffordshire district. The *Mining Journal* is a well-known newspaper and organ of British mining interests, established more than twenty years ago. It contains, of course, numerous advertisements of stockbrokers, manufacturers, and artizans; and in it are given the prices of shares, details of the mining markets, reports of companies, and correspondence on subjects of passing moment or discussion. But what renders it of most value to the geologist, are its copious reports of public lectures by the Government Survey officers and other competent gentlemen, delivered at various places; its excellent reports of mining works, machinery, and districts, and other good articles on matters of real economic geology.

Museum of the late Hugh Miller.—At the invitation of the Lord Provost a preliminary meeting was held on Monday, 12th April, in the Council Chambers, at which he stated that he had called this meeting in consequence of the strong desire felt and expressed in many quarters that the Geological Museum collected by the late Mr. Miller, should be secured for Scotland, and deposited in the New Industrial Museum of Edinburgh. An application had been made to the late Government with a view of inducing them to become the purchasers. They had cordially entered into the project, and a sum of £500 had been set aside by them for this object. Two other offers, however, had been received—the one from a Scottish nobleman, of £1,000, and the other from an American College, of one thousand guineas. It would require, however, that their grant should be supplemented so as to make up the whole sum at least to £50 above the highest offer, before Mr. Miller's family could be asked to carry out their desire to have the museum permanently deposited in Edinburgh. It appeared to his lordship that a vigorous effort should be made to prevent the museum being carried across the Atlantic; that no more suitable memorial of the genius and scientific labours of Mr. Miller could be erected and preserved. It was unanimously resolved, that a subscription list should be immediately opened, and the following sub-committee was appointed to prosecute the subscription with as little delay as possible:—Professors Simpson, Allman, George Wilson, Miller, and Balfour; the Rev Dr. Hanna, Dr. Smith; Messrs. R. Horn, R. Paul, David Maclagan, D. S. Anderson, James Duncan; the Lord Provost, convener; Mr. Leckie, of the Commercial Bank, treasurer; Mr Constable and Dr. George Lawson, secretaries. Subscriptions may be remitted by Post-office Order, or otherwise, to the treasurer, or paid to any branch of the Commercial Bank.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—April 28.—The following communications were read:—1. "On some Fossil Plants from Madeira." By C. J. F. Bunbury, F.R.S., F.G.S.

The vegetable remains described in this memoir were procured by Sir C. Lyell and M. Hartung from a leaf-bed discovered by them in January, 1854, in the ravine of S. Jorge, in the Island of Madeira (Journ. Geol. Soc. vol. X. p. 326). They consist of detached leaves and fragments of leaves, mostly in a very imperfect state—a large proportion of them, indeed, too imperfect to be described. Dicotyledonous leaves predominate, but remains of ferns are also numerous; always, however, in a very fragmentary condition. Monocotyledons are rare. No distinct remains of fruit have been found.

Mr. Bunbury described twenty-three different forms (8 Ferns, 1 Monocotyledon, and 14 Dicotyledons), which he has been able to discriminate among these remains; and added a list of those described by Professor Heer, in his memoir on the same subject. Each list contains several that are wanting in the other · M. Heer has thirteen which are not found in the collection examined by Mr. Bunbury; and the latter collection contains twelve that do not seem to be noticed by the Swiss Professor. The total number of distinguishable forms in the two collections amounts to thirty-seven; the greater part of which must be considered as very imperfectly known. They gave occasion to the following remarks:—

1. The most abundant of the Dicotyledonous leaves and the most abundant of the ferns are, with great probability, identified with species now existing in the Island; namely, *Laurus Canariensis*, *Oreodaphne fœtens*, and *Pteris aquilina*. The *Pteris* is a plant which has a wide geographical range, and accommodates itself to a variety of conditions; but the two laurels appear to be confined to the three Atlantic groups of Islands, the Madeiras, Canaries, and Azores. Four other of the fossils appear to be very probably referable to species now inhabiting Madeira; namely, *Vaccinium Maderense*, *Erica arborea*, *Woodwardia radicans*, and *Davallia Canariensis*. Of these, the *Vaccinium* is at present restricted to the Island of Madeira; the others have a wider range. These facts may, perhaps, justify us in inferring (though certainly not with confidence), that the conditions of climate of the Island in the time of the S. Jorge deposit were not very widely different from those now existing.

2. Certain other forms in the list (about four or five) are distinctly different from any now known, at least in Madeira or the neighbouring Islands, and appear to belong to extinct species.

3. None of the fossils can be said to belong distinctly and positively to tropical families.

4. Those forms, among the fossils, which are different from the present vegetation of Madeira, do not show any marked analogy to the American or any other existing Flora.

5. The fossil leaves from S. Jorge show, on the whole, a decided analogy to the recent vegetation of the Madeira forests, inasmuch as there is among them a predominance of undivided and entire-edged leaves, with smooth (not wrinkled) and glossy surface.

6. The intermixture of abundant remains of ferns with those of Dicotyledons is a characteristic of this leaf-bed, in which it shows a complete agreement with the existing state of things in the Madeira forests. Such an intermixture is not usual in the plant-bearing deposits of the palæozoic, secondary, or tertiary periods.

7. The very small number of Monocotyledons hitherto found is remarkable, but may be owing to accidental causes.

8. On the whole, the author is disposed to conclude that the vegetation of Madeira, at the time when the S. Jorge leaf-bed was formed, was, though not absolutely identical with that now existing, yet not very different from it. But all such conclusions must be received with great caution.

Mr. Bunbury moreover entered at some length into an inquiry as to the value of the evidence afforded by detached leaves of Dicotyledonous plants, and the degree of confidence due to conclusions founded upon such evidence, as to the affinities of extinct plants.

2. "On a section of a part of the Fifeshire Coast." By the Rev. T. Brown. Communicated by Sir R. Murchison, V.P.G.S.

A section of the Lower Coal-measures, as exposed on the northern shore of the Firth of Forth, from Burnt-island to Anstruther, constructed by the Rev. T. Brown, of Edinburgh, was exhibited to the meeting. In his notes on the section, the author remarked that the limestone with which the section commences at Burnt-island, the fossils of which have long been known, is the equivalent of the Bardiehouse beds. Passing eastward through the Mountain-limestone (500 feet thickness of sandstone, shale, and five or six beds of limestone), with trap-rocks, the section reaches the Upper Coal-measures (1,700 feet thick). Crossing this coal-basin, the same Mountain-limestone beds reappear in reversed order, fold over an axis beyond Elie, and, after minor bendings, plunge under the basin of St. Monance, and rise again to the east. Between Elie and St. Monance the strata are singularly contorted; and an important fault runs nearly parallel with the coast, causing much confusion. Beyond St. Monance the section becomes clear, and, passing through the Mountain-limestone down to the level of the Burdiehouse beds, as at Burntisland, exhibits a magnificent series of the Lower Carboniferous rocks, consisting of freshwater or estuarine shales and sandstones, with a few bands of limestone, one of which latter is of marine origin. *Sphenopteris affinis* characterizes the upper portion of this inferior group; and *Cyclopteris* its lower portion. The Burdiehouse limestone belongs to the upper portion; and, like the other calcareous bands, thins out eastwardly. The Grantham beds, on the contrary, appear to belong to the lower portion.

The fossils of the four limestone-bands in the upper part of the Mountain-limestone are *Zaphrentis*, *Orthis filaria*, *Productus punctatus*, *P. semireticulatus*, *Aviculopecten*, *Modiola*, *Loxonema rugifera*, *Orthoceras*, *Nautilus subsulcatus*. The fifth band and its accompanying bone-bed contains *Productus semireticulatus*, *Aviculopecten*, *Spirifer duplicostatus*, *Cochliodus*, and *Ctenacanthus*. The lowest band (at Ardross) has *Nucula tumida*, *N. attenuata*, *Schizodus sulcatus*, *Goniatites*, *Natica*, *Serpulites*, *Holoptychius Hibberti*, *Eurypterus ?*, *Gampsonyx*, *Dithyrocaris*. The upper half of the Lower Carboniferous series contains *Sphenopteris affinis*, *Cypris ?*, and *Palæoniscus*. The marine band, in the middle of the series, has *Encrinites*, *Fenestella*, *Nucula tumida*, *N. attenuata*, and *Productus semireticulatus*. The lower half of the series has *Cyclopteris*, *Stigmaria*, *Carpolithes*, *Cypris ?*, *Pterichthys ?*, and *Eurypterus*.

3. "On the Lower Carboniferous Coal-measures of British America." By J. W. Dawson, LL.D., F.G.S.

Deposits indicating the existence of the Coal-flora and its associated freshwater fauna at the beginning of the Carboniferous period are well developed in Nova Scotia and New Brunswick, with a clearness and fulness of detail capable of throwing much light on the dawn of the terrestrial conditions of the Coal-period, and on the relations of these lower beds to the true coal-measures. This lower series comprises shales and sandstones (destitute of marine remains, but containing fossil plants, fishes, entomostraca, worm-tracks, ripple and rain-marks, sun-cracks, reptilian footprints, and erect trees) and great overlying marine limestones and gypsums. These are distinct from the true coal-measures by their position, mineral character, and fossil remains. In the western part of Nova Scotia (Horton, Windsor, &c.) the true (or Upper and Middle) Coal-measures are not developed; and here the Lower Carboniferous marine deposits attain their greatest thickness. The lower coal-measures (or Lower Carboniferous freshwater or estuarine deposits) have here a thickness of about 600 feet. These beds are traceable as far as the Shubenacadia and Stewiacke Rivers. They outcrop also on the south side of the Cobequid Mountains, where the marine portion is very thin, owing perhaps to the fact of these mountains having been land in the coal-period.

Along the northern side of the Cobequid Range the upper and middle coal-measures and the marine portion of the Lower Carboniferous series are of a great thickness. The freshwater beds are absent here, though brought up on the northern side of the coal-trough of Cumberland, where, as well as in New Brunswick (Petitcodiac River, &c.), they are remarkable for their highly bituminous composition, their well-preserved fish-remains, and the almost entire absence of plants. To the north, at the Bay of Chaleurs, the great calcareous conglomerate, with sandstone and shale, 2,766 feet thick, described by Logan, and containing a few plant remains, probably represent the Lower Coal-measures of Nova Scotia. In eastern Nova Scotia and Cape Breton the Middle Coal-measures are found at Caribou Cove and elsewhere; the marine limestones and gypsums, and the underlying sandstones and shales, are seen at Plaister Cove; also at Right's River, and St. Mary's River.

In Nova Scotia these older coal-measures, as compared with the true coal-measures, are more calcareous, more rich in remains of fishes, and have fewer vegetable remains, and indications of terrestrial surfaces. They occur generally along the margins of the coal-areas, near their old shores; and, as might be expected under such circumstances, they are associated with or replaced by beds of conglomerate derived from the neighbouring highlands of Devonian or Silurian rocks. When the conglomerates are absent, alternations of sandstones with sandy and calcareous shales occur, with frequent changes in character of the organic remains; the general aspect being that of muddy estuarine deposits, accumulated very slowly, and discoloured by decaying organic substances. The supply of sediment, and the growth and preservation of vegetable matter, appear to have been generally on a smaller scale in this early carboniferous period than subsequently. In those districts where the true coal-measures are least developed, the lower series is most important; showing that the physical and vital conditions of the Coal-measures originated as early as those of Mountain-limestone; and that locally these considerations may have been contemporaneous throughout the whole period; but that in some localities the estuary and swamp deposits first formed were completely submerged and covered by oceanic deposits, whilst in others early marine beds were elevated and subjected to the conditions of gradual subsidence and vegetable growths indicated in the great coal-measures of the South Joggins, Pictou, and Sidney.

In Nova Scotia the Lower Coal-measures are characterized by a great preponderance of *Lepidodendra* (especially *L. elegans*) and *Poacites*. The Middle Coal-measures are rich in *Sigillariæ* and Ferns, as well as *Lepidodendra*. The Upper Coal-measures especially abound in Conifers, Calamites, and Ferns. *Palæoniscus*, *Gyrolepis* or *Acrolepis*, *Centrodus*, *Rhizodus*, and *Ctenacanthus* are the chief fossil fishes of this Lower Carboniferous series. Unio-like shells are nearly the only remains of Molluscs.

4. "On the Structure of *Stigmaria ficoides*," By E. W. Binney, Esq., F.G.S.

The author, having lately met with several specimens of this singular root which exhibit good structural characters, was enabled in this paper to throw some additional light on the origin of the medullary rays in *Stigmaria*, the nature of the vascular bundles which were believed to be dispersed throughout its pith, and the structure of the central or vascular portion of its rootlet,—points of considerable interest, and which up to the present time have not been well determined. Mr. Binney confirms Dr. Hooker's view of the medullary rays having originated in the cellular axis of the stem. The axis, in one of the author's specimens, is seen to be filled with eleven or twelve large vessels, each about 1-10th of an inch in diameter, and having very thick walls: these elongated utricles lie close together, are not dispersed in a cellular tissue, are somewhat similar to those described by M. Brongniart as occurring in the woody part of *Sigillaria elegans*. In a rootlet Mr. Binney finds evidence of an outer ring of fine cellular tissue, three or four cells broad, and in the centre of the middle space twenty-seven large, and eleven smaller vessels, forming a mass of vascular tissue 1-90th of an inch in diameter, the vessels or utricles being distinctly marked with transverse striæ.

5. "On a New Fossil Fern from Worcestershire." By John Morris, Esq., F.G.S.

A few fragments of fern-leaflets, found by Mr. G. Roberts, of Kidderminster, in a micaceous sandstone about two miles north-east of Bewdley, exibit a reticulate venation; a character comparatively rare in the Coal-measures. These specimens are but fragments of the frond; and the one particularly referred to is probably the terminal part of a pinna. The author doubtfully referred it to the genus *Woodwardites*, with the specific name *Robertsi*.

May 12, 1858.—1. "On some of the Glacial Phenomena of Canada and of the North-eastern Provinces of the United States during the Drift-period." By Prof. A. C. Ramsay, F.R.S., F.G.S.

The author first described the evidently glacialized condition of the great

Laurentine chain of mountains, on the north side of the St. Lawrence, which for an extent of 1,500 miles exhibit, often in spite of the forest, unequivocal signs of glacial abrasion, being mammillated (or moutonnées), as if by the action of ice.

On the south side of the river, the country is low, and covered with boulder and other drifts, derived from the Laurentine Chain and other tracts, in accordance with the observations of Bigsby, Hitchcock, and others. The plains and the Thousand Islands exhibit a general glacialization. These conditions are traceable down the Valley of the Hudson to New York.

During the period when the boulders and the associated clays and gravels were being deposited, the Catskill Mountains appear to have been under water, and at about the same period to have been subjected also to very extensive glacial action. The striæ left by ice-borne rocks on the eastern flank of the Catskills have a north and south direction, and are found up to nearly the height of 3,000 feet above the sea, excepting in the east and west gorges near the top, where the striæ run in a cross direction—E. and W. The sea of the drift-period in the Valley of the Hudson was then from 3,000 to 4,000 feet deep. The deep valleys on the western side of the mountains were observed by Prof. Ramsay to be often charged with drift, which had not been ploughed out by glaciers of a date subsequent to the upheaval of the Catskills, as is the case with some of the valleys, once occupied by drift and afterwards by glaciers, in Wales, the Highlands, the Vosges, and in the Alps.

Prof. Ramsay then referred more particularly to the drift-deposits forming terraces in the neighbourhood of Montreal, which have lately been described in detail by Dr. Dawson; and pointed out his reasons for regarding the Leda-clay of Dawson to be of contemporaneous formation with the Nucula-clay of the eastern side of Lake Champlain, and with the clay-beds of Albany and elsewhere on the Hudson. The clay of the Hudson Valley lies on boulder-beds, and rarely contains boulders. Along Lake Champlain similar clays overlie old drift, at about 150 feet above the sea-level, and contain fossils similar to those of the Montreal clays, at 140 feet above the sea, and of other contemporaneous beds on the Ottawa. Prof. Ramsay assumed Dr. Dawson's conclusion as to the age of the Leda-beds, which were deposited, in a thickness of from 100 to 300 feet, over the boulder-clay, whilst the sea covered the Ontario basin, and came up against the great escarpment of Niagara limestone, which, now stretching across this region, formed the southern coast of the glacial sea.

The author then inferred that, the Erie plateau having been elevated, *the falls of Niagara commenced*, by the drainage of the upper lake-area, *a little before the close of the drift-period*, falling first into the sea over the edge of the escarpment above Queenstown and Lewistown. If the 35,000 years suggested by Sir C. Lyell as the minimum for the time occupied in the erosion of the gorge of Niagara be approximately correct, though probably below the reality, we have an idea of the amount of time that has elapsed since the close of the drift period. And, if it be ever found possible to accurately determine the ancient rate of recession, we shall have data for a first approach to an actual measurement of a portion of geological time. This subject is intimately connected with the synchronism of the mastodon-bearing freshwater strata of Niagara and those of the bluffs of the Mississippi.

2. "On Lamination and Sleavage occasioned by the mutual friction of the particles of rocks while in irregular motion." By G. Poulett Scrope, Esq., M.P., F.R.S., F.G.S.

The author referred to a former paper read by him before the Society in April, 1856, in which this subject was touched upon, and proposed to carry on the inquiry as to the probable effect upon the internal structure of rocks, of the mutual friction of their component parts when forced into motion under extreme and irregular pressures. He commenced by examining the laws that determine the internal motions of substances possessing a more or less imperfect liquidity, whether homogeneous, or consisting of solid particles suspended in, or mixed with, or lubricated by, any liquid, under unequal pressures; and showed that unequal rates of motion must result in the different parts of the substance, and that in the latter case, there will be more or less separation of the solid and coarser from the finer and liquid particles, into different zones or layers; those composed of the former moving less readily than those composed of the latter; and also that the former will, by the friction attending this process, be turned round so as to bring their major axes into the line of direction of the movements; and, if susceptible of tension or disintegration, will be elongated or drawn out in the same direction.

In illustration of this law, specimens of marbled paper were produced, being impressions from superficial films of coloured matter floating upon water in circular or irregular forms, after they had been subjected to motion in one or more directions by lateral pressure; the appearances produced bearing a very exact resemblance to those presented by the lamination and occasionally sinuous or contorted structure of the ribboned lavas of Ponza, Ischia, the Ascension Isles, &c., as well as that of gneiss and mica-schist.

The author proceeded to state that the expansion of a subterranean mass of granite by increase of temperature, to which all geologists agree in ascribing the elevation of overlying rocks, *must* be accompanied by great internal movements and consequent mutual friction among the component parts, and even among the individual crystals; that if a lubricating ingredient, such as water holding silex in solution, or gelatinous silex, be intimately mixed up with the more solid crystals (as there is great reason to believe to have been the case in granite), the friction will be lessened, especially in the central or inferior parts of the mass, where the expanding movement, or intumescence, may be supposed nearly uniform in all directions. But in the lateral and higher portions directly exposed to the resistance and pressure of the overlying rocks shouldered off on either side by the expanding granitic axis, the movement will probably have been so predominant and extreme in a direction at right angles, or nearly so, to the pressure, as to give rise to a lamellar arrangement of the solid crystals, in the manner before indicated. In this manner he supposes the foliation or lamination of gneiss and mica-schist to have been produced through the "squeeze and jam" of the lateral and superficial portions of a granite mass expanding by increase of temperature, and the giving way of the overlying rocks, those portions being forced to move in the direction of the lamination while subject to intense pressure at right angles, or nearly so, to that direction. The author argues that it is not inconsistent with this view, to suppose that a certain amount of re-crystallisation may have accompanied or followed this lamellar arrangement, in which case also the major axes of the crystals would be likely to take a direction perpendicular to the pressure, since the mobility necessary to the crystallific action will have been freer in that than in any other direction. He likewise points out that the influence of internal friction accompanying motion under extreme and irregular pressures, must have been equally operative in the case of aqueous as of igneous rocks, under similar circumstances of imperfect liquidity, and irrespective of changes of temperature. And he suggests that to this cause may be attributable the internal structure of some veined marbles, calcareous breccias, serpentines, &c.; as well as the cleavage of the slaty rocks; as, indeed, the experiments of Mr. Sorby and of Professor Tyndall have already indicated. He concludes by suggesting to all geologists engaged in the examination of rocks the above mechanical considerations, as likely to lead to more definite views than at present prevail as to the origin of the metamorphic schists, and the internal structure of many of the older and more disturbed rocks of all characters.

WARWICKSHIRE NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY AND FIELD CLUB.—The council of this Society, in their twenty-second annual report, read at the anniversary meeting on the 9th April last, announce numerous and valuable additions to their museum and library; but they appear, as we gather from the report, to be deficient in local objects and books, &c., relating to their county. This is the great defect of most local museums, and that which causes too many of them to be justly regarded as mere curiosity-shops. The council, however, appear to have appreciated fully the proper objects of a local museum, and have boldly and wisely drawn attention to this point. Several new cases have been added to the geological department, and, by a recent arrangement, space has been obtained for additional specimens, which are now therefore *desiderata*. An application to the Geological Survey of Great Britain has been liberally responded to by a present of a large number of fossils from various formations; and a series of Hampshire Tertiary fossils has been presented by R. Chattock, Esq. "Still, any further addition," the report says, "to the Eocene Tertiaries, and any fossils from the Hempstead and Bembridge series and Sconce limestone, from Cowes, Ryde, and Headon Hill, Isle of Wight, from Hordwell, Hampshire, and from Bracklesham Bay, in Sussex, will be very acceptable. Of the Cretaceous group and Upper and Lower Greensands, fossils are still wanted. There are, in the museum, but few Oolite fossils. In the Devonian system there are only half a dozen specimens from the Old Red Sandstone, and there are scarcely any from the Lower Silurian." The Geological Collection referred to is an excellent and instructive one, and deserves to have these deficiencies remedied. An account of the meetings of the Field Club, during the last year, detailed in this report, were given in the GEOLOGIST of February last (No. II., p. 77-80).

REVIEWS.

The Student's Manual of Geology. By J. BEETE JUKES, M.A., F.R.S., Local Director of the Geological Survey of Ireland. Edinburgh: Adam and Charles Black.

"EARLY in the year 1851," writes Mr. Jukes in his preface, "the late Edward Forbes asked me to be his fellow-labourer in writing the article on geology in the new edition of the 'Encyclopædea Britannica,' and a text-book to be founded on it." This was the origin of the present work, now, alas! completed without the aid of that master-spirit whose loss this generation of British geologists will never cease to deplore.

The author separates his whole subject into three divisions—(1) Geognosy, (2) Paleontology, and (3) The History of the Formation of the Series of Stratified Rocks. In using the term geognosy, so common among continental geologists, Mr. Jukes restricts the meaning within narrower limits, for he describes it as "the study of the structure of rocks independently of their arrangement into a chronological series," while German geologists include the consideration of the chronology of rocks in the term. Geognosy he again divides into two parts—lithology and petrology—which he thus defines: "By Lithology I would mean the study of the internal structure, the mineralogical composition, the texture, and other characters of rocks, such as could be determined in the closet by the aid of hand-specimens. Under Petrology I would arrange the larger characteristics of rocks, the study of rock-masses, their planes of division, their forms, their position, and mutual relations, and other characters that can only be studied in the field, but without entering on the question of the geological time of their production." This first division of Mr. Jukes' work is characterized by much special information and by many peculiar excellences.

The second and third divisions, without being marked by any very novel feature, are excellently arranged, and to the student, or, indeed, to any geologist, afford an invaluable means of ready reference. The former, paleontology, although treated with great conciseness, is stamped by broad philosophical views, founded mainly on the teaching of Edward Forbes, "gathered either from his works or from conversations with him on the subject." On the classification of the sedimentary strata, Mr. Jukes' arrangement differs in some details from that generally adopted. For instance, he classes the rocks usually called the Upper Old Red Sandstone in Scotland, the Upper Devonian in Devonshire (the Marwood, Pilton, and Petherwin beds), and the Upper or Old Red Sandstone proper of the south of Ireland and South Wales, as Carboniferous strata, placing them at the base of that system.

Dr. W. K. Sullivan, Professor of Chemistry at the Irish Museum of Industry, has greatly aided Mr. Jukes in the chemical description of the rock-forming minerals. Many of Dr. Sullivan's observations—which are incorporated with the text—are excellent, and give the clearest views on the subject. There is, however, one point which we think should be pointed out and set right, for if unnoticed, it may place the Doctor in a false position with foreign *savants*. In his preface Mr. Jukes thus writes: "Dr. Sullivan also examined these descriptions for me, and pointed out a certain relation which might be traced in them, between the proportions of oxygen in the acid and that in the base, by means of which relation the close connection between allied minerals is made more obvious, and placed on a more systematic basis than hitherto. It will be, I believe, of interest and importance to the chemical mineralogist." Now, persons unacquainted with inquiries in this branch of geology might, from this statement, be led to suppose that the relation referred to—which is of the highest importance—was first noticed and investigated by Dr. Sullivan. This is not the case; and we are assured the Doctor would not wish such an impression to be conveyed. For some years this relation has been made the basis of classification for minerals and rocks by many continental geologists. A great part of Bischof's reasoning is entirely founded on this relation, which he certainly states in a different form, and calls the *oxygen-quotient*; but that it is essentially the same will be evident by the following reference. After pointing out the little value to be attached to the ordinary formulæ by which the chemical composition of minerals is represented, he proceeds: "The ratio of the oxygen of the silica, and that of the whole of the base, is, on the contrary, independent both of the portion of the bases as monoxides or sesquioxides, and of the orders to which the several silicites belong."—(Translation Cavendish Society, vol. ii., p. 88.)

In general arrangement this *Manual* is founded on that of Naumann's "Geognosie." Mr. Jukes' division of lithology answers to Naumann's *Petrographie*, and his petrology to the latter's *Geotektonik*; they have the division paleontology in common. Mr. Jukes' third part answers to Naumann's second volume; and in the excellent arrangement of the characteristic fossils of each formation, in the mode of marking those that were introduced or became extinct, he also follows the German geologist.

On the theoretical principles of geology, the author is an earnest disciple of the views of Sir Charles Lyell, which he propounds with a greater distinctness, perhaps, than they have hitherto been set forth. The whole question of the metamorphism of sedimentary into crystalline rocks, and the doctrine of the hypogene derivative origin of granite, are fully and clearly stated.

From what we have said, although portions are more adapted to the service of authors than of students, we need scarcely add we recommend this work to our readers.

THE GEOLOGIST.

JULY, 1858.

THE IRONSTONE-FORMATION OF THE FOREST OF DEAN; WITH A SKETCH OF THE GENERAL GEOLOGY AND INDUSTRIAL HISTORY OF THE DISTRICT.

By Dr. J. J. W. Watson, F.G.S.

(*Continued from page* 226.)

Millstone Grit.

The coal-measures repose conformably on a series of grit-beds, all more or less charged with oxide of iron, and measuring together about 500 feet in thickness. In some places a bed of limestone intervenes between the lowest bed and those above, but the general section, in descending order, is as follows:—

1. Coarse red grit-stone, called "The Miner's Farewell Rock."
2. Light red sandstone, with layers of variegated marls, which, although partly indurated in the bed, fall to pieces by exposure to the air.
3. Fine-grained quartzose grit, much charged with iron in the middle beds, constituting the "Sandstone Mine Formation." In this group there are two thin beds of coarse conglomerate, or pudding-stone.

Coal Measures.

It would be impossible for me to enter into any adequate description of this most important part of the Forest geology, without extending this article to an undue length. The following summary, therefore, must suffice, in the present instance; although I purpose describing the coal-field, which has special interest—geological as well as industrial—on another occasion.

If the ordnance geological sheet No. XLIII. S.E. be examined, with the horizontal sections Nos. 15 and 16, a very good notion of this coal-basin may be obtained, although not too much dependence is to be placed, practically, on the position of the lines marking the crop of the several veins. Indeed, to lay down the line of crop accurately, in many places where there are no workings, is impossible, from the thickness of the over-burden or soil: besides which, the theoretical lines invariably require to be shifted, from the occurrence of minor faults and local denudation.

The measures may be conveniently divided, in descending order, into—

1. The rock series.
2. The shale or argillaceous series. The Brazilly vein of coal being taken as the line of demarcation between the two.

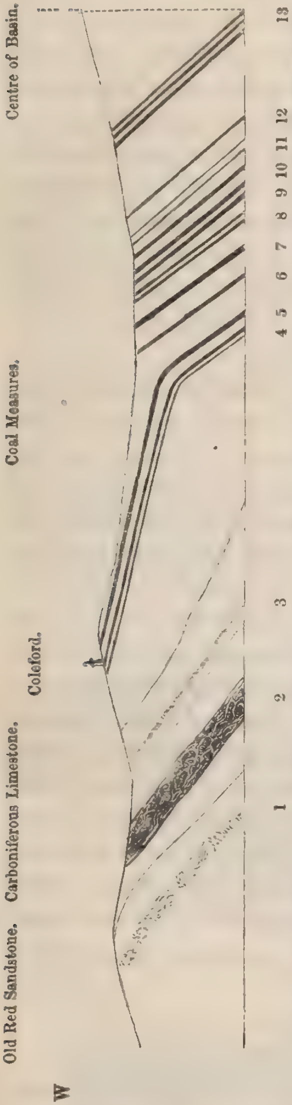
The Brazilly rock furnishes a free-stone, said to have been quarried for the hearths of the charcoal iron-furnaces formerly in use.

The upper series may be further subdivided by a straw-coloured sandstone, thought, by some, to represent the Pennant-rock of the Somersetshire coal-fields.

Adopting the arrangement given, the following will be the order of the coal seams:—

1. Woorgreen's coal: three small seams of an aggregate thickness of four to six inches. In the lowest bed of the alternating sandstone is found a thin band of ironstone, formerly worked to a small extent.
2. The smith's coal; Lowrey or Park End High Delf; Starkey Vein, Rocky Vein, and Upper and Lower Churchway Veins. These veins alternate with impure sandstones and sandy shales, locally called "Cliff" and "Stone-bind." United thickness of these coal-seams, about five yards. In the clay between the Starkey Veins, which are double, and worked together, argillaceous ironstone is met with, but in sparing quantities. The veins in this series extend over an area of about 7,000 acres.
3. The Nag's Head Vein, Whittington Delf Vein, Coleford High Delf Vein, and Upper and Lower Trenchard Veins—the whole thickness about 17 feet. Of these, the Coleford High Delf is

the most important, and extends over between 15,000 and 16,000 acres. The intervening beds of rock of this division are sandstones and grit-stones; and the bed immediately under the Upper Trenchard seam is coarse shale, containing a band of argillaceous ironstone nodules—locally called "cherkers,"—and known as the "Blue Ball Vein." This band, although it has been only very little explored, is probably of considerable economic importance. Below the Lower Trenchard Vein is a deposit, ten yards thick, of fire-clay, which is most extensively worked for the manufacture of fire-brick.



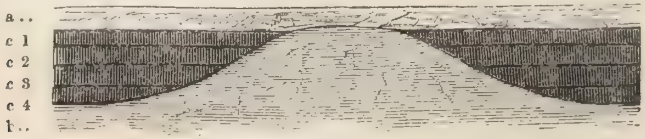
Lign. 2.—1. Conglomerate Beds. 2. Great Ironstone Formation. 3. Sandstone vein of Iron Ore. 4. Upper and Lower Trenchard Veins. 5. Coleford High Delf Seam. 6. Whittington Delf Seam. 7. Nag's Head Seam. 8. Upper and Lower Churchway Seams. 9. Rocky Seams. 10. Starkey Seams. 11. Park End High Delf Seam. 12. Smith's Coal Seam. 13. Woorgreens Coal Seam. [Note.—In the section the double lines for the Starkey seams should have been represented below (underlying) the Park End High Delf Seam, which should have been marked by a single thick line.—J. J. W. W.]

The aggregate thickness of the coal measures is about 35,000 feet, and the over-clays or "clod tops," of the coal seams, together with the argillaceous rocks and shales, contain a vast variety of fossil vegetable remains.

One fact concerning the occurrence of these remains is worthy of note. It is this: the over-clays alone have contained the fossils yet discovered, and the vegetable markings, often mere carbonaceous spots, extend upwards into the rock which is superincumbent, but they are not found in that which underlies the coal-seam. If I may venture an explanation, I would suggest that the origin of the coal-seams—and the history of one seam is nearly the history of them all—was probably a peat-bog, that, through subsidence, became covered with water to a sufficient depth to admit of land plants being washed from the shores; and these, becoming loaded with mineral matter, sank and were imbedded in the mud: the lighter portions of the plants, such as the stems, leaves, and parts of the bark, would remain a longer time suspended, but would at last sink and be buried in the accumulating silt, afterwards to form those carbonaceous spots we now find intercalated in the stone.

The overclays of the Coleford High Delf seam, and many of the other veins, contain numerous impressions of ferns (Pecopteris), as well as some fine trunks of Sigillariæ. By far the greater number of the latter, however, are found in the sandstone beds, where they have usually their roots (stigmariæ) attached. I have often seen, in tolerable abundance, in the roof of the Coleford High Delf seam, the casts of a shell resembling a Cyclas.

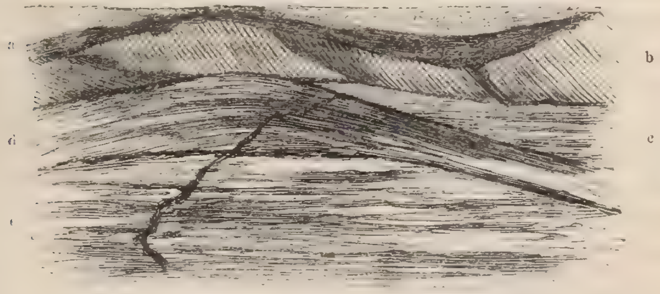
The coal-measures of the Forest of Dean present us, perhaps, with fewer examples of faults and dislocations of strata, the presence of igneous dykes, or of subterranean disturbance on a large scale, than any other British coal-field of similar size. We have, however, in this field certain interruptions to the continuity of the coal-seams, which are locally termed faults, but which have derived their existence from channels cut by running water, similar to those examples of erosion still to be observed in extensive bogs, and to pristine irregularities in the surface of the bed on which the vegetable matter subsequently formed into coal was deposited. The latter kind of fault is exceedingly common, and often completely "cuts out" the coal, manifesting its origin, however, by the undisturbed bedding of the coal, ending smoothly on either side of the interruption, as well as by the very gentle inclination with which its outline rises from the floor. The subjoined diagram illustrates an example from a colliery I am working at Ruardean. In this case, the fault was formed by a bank, the lineal extension of which is yet undiscovered, but which was upwards of forty yards in average breadth, and formed, in all probability, a small spit of land which projected into the morass.



Lign. 3.—Coal-Seams "cut out" by a "horse," Ruardean. a, Clod-top (roof); b, underclay (sole); c, 1, 2, 3, 4, coal-seams.

I may cite, as a capital instance of the kind of fault produced by erosion, the "Horse," which occurs in the Coleford High Delf Vein, and which has been followed over two miles in length, presenting an average breadth of 260 yards. Mr. Buddle has described the circumstances connected with this fault, and has represented certain minor phenomena, of apparently the same description, known as the "Lows," as tributaries to the ancient main channel ("Geological Transactions," Vol. VI). I am inclined, however, to refer the greater number of the "Lows," or so-called subsidiary channels, to the same origin as the fault at Ruardean, which I have just described, and I am supported in this view by the fact, that the quartz pebbles and rolled pieces of coal, which are found in the sand and drift (now converted into sandstone), that occupied the main channel, do not occur in the "Lows,"—which, moreover, are not all of them *connected*, as represented in Mr. Buddle's plan, with the "Horse."

In the sandstone of the coal-measures many instances occur of irregular and oblique lamination, affording a proof that the beds were not formed by the gradual deposition of particles mechanically suspended in the water, but rather by drifts of sand pushed along the bottom by the action of currents. The following section was sketched near Cinderford Bridge:—



Lign. 4.—Drift-bedding in Sandstone, near Cinderford Bridge.—a, b, c, d, e, Beddings inclined at various angles.

IRON ORE FORMATION.

I have mentioned, incidentally, that between the double veins of the Woorgreen and Starkey coals, and beneath the Upper Trenchard Vein, there occur in beds of shale bands of ironstone of sufficient thickness and value, in places, to be worked. These ironstones are all of a similar argillaceous character, and contain from 30 to 34 per cent. of iron, giving off water to the amount of from 32 to 35 per cent. of their weight by torrefaction.

But, by far the most important produce of the Forest are the Brown Hæmatite ores, or hydrated per-oxides, which occur in such vast quantities, in what are called the "Mine Measures," and which, as already described, occupy the upper beds of the carboniferous limestone and the lower beds of the millstone grit. The diagram, page 226, shows a section of the "Mine Measures," and the section, page 267, shows the complete sequence of the beds in connection with the overlying Coal Measures.

The ores are usually classified into 1, "Brush;" 2, "Smith Mine;" and 3, "Clod."—1. The Brush-ore is a hæmatite, containing as much as 80 per cent. of iron, when pure; is compact, of a submetallic lustre, botryoidal, kidney-shaped, formed of concentric coats, and having a fibrous or radiated structure. More often, however, it is stalactitical, and covered with brilliant black crystals of hydrous oxide of iron, which are often so minute and so thickly aggregated as to confer a velvetty appearance of great beauty. The local term "Brush" is probably derived from this stalactitic form.

2. The Smith-ore consists of finely powdered per-oxide of iron, which occurs so pure as to be raised almost entirely free from extraneous minerals; it usually contains from 54 to 58 per cent of iron.

3. The Clod is a marl highly charged with the per-oxide of iron, and with small fragments of compact hæmatite or "brush." It is found under particular circumstances, to which I shall presently allude, and is valuable to a certain extent as a "flux" from the contained alumnia.

The following are some analyses made by me of (average) samples of Forest of Dean ores:—

	No. 1.	No. 2.	No. 3.	No. 4.
Per-oxide of Iron	62	70	80	86
Carbonate of Lime	10	0	3	0
Silica	6	12	6	10
Alumina	4	0	0	0
Carbonate of Magnesia	2	4	0	0
Manganese	2	0	1	0
Water and Loss	14	14	10	4
	100	100*	100	100†

From this mineralogical description of the ores, let us turn to the consideration of the petrological conditions under which they are found. By referring back to the arrangement I have sketched at page 225, of the marine carboniferous series (limestone), it will be seen that the ironstone formation caps division No. 3, and is immediately overlaid by the White Head limestone. (See also the section, page 226.) The White Head limestone is a regularly stratified rock; the beds are often highly crystalline, and do not contain, as far as I am aware, any fossils. The limestone rocks and calcareo-argillaceous shales below the ironstone formation comprises the grey and red beds, which are also regularly stratified, but contain, as already described, a moderate quantity of organic remains. I draw attention to this fact of the rocks above and below the "Mine Measures" being regularly stratified, because in the whole extent of this formation, which has an average vertical thickness of twenty-five yards, not one single instance of lamination or "bedding" has been detected. The entire mass forms a single bed, so to speak, of cavernous limestone, the caverns being filled with the crystallized and powdery hæmatite-ores which have been described. This limestone is locally called "crease," and is traversed by innumerable small joints, which exhibit such a total want of symmetry in their arrangement as to render it impossible to attribute their origin to any force acting in any given direction. In one spot, one set of joints will run with sufficient regularity over a short distance to be easily mistaken for planes of stratification; at another spot another set will exhibit the same appearances, but in a totally different direction; and both, within a very limited area, will be gradually confused and obscured by a third set cutting them promiscuously. The resemblance in these joints to what may be observed in highly crystalline igneous rocks, such as granite, where they owe their existence probably to an internal shrinking in the consolidation of the mass, is worthy of remark. The worked-out spaces in the "Mine Measures" in which the ore has been removed, and the limestone buttresses, or "crease," alone left standing, forming natural pillars and arches, remind one of the crypt of a cathedral—or, as the caverns occupy somewhat parallel positions in the bed, a series of crypts piled one over the other: indeed, the rude symmetry which in many places is maintained in the position of the buttresses and the regularity of the passages, render it difficult to, at once, disarm the mind of the fact of the non-existence of any artificial means, beyond removing the ore, having been employed in producing the illusion. Connected

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* From Sandstone Vein.

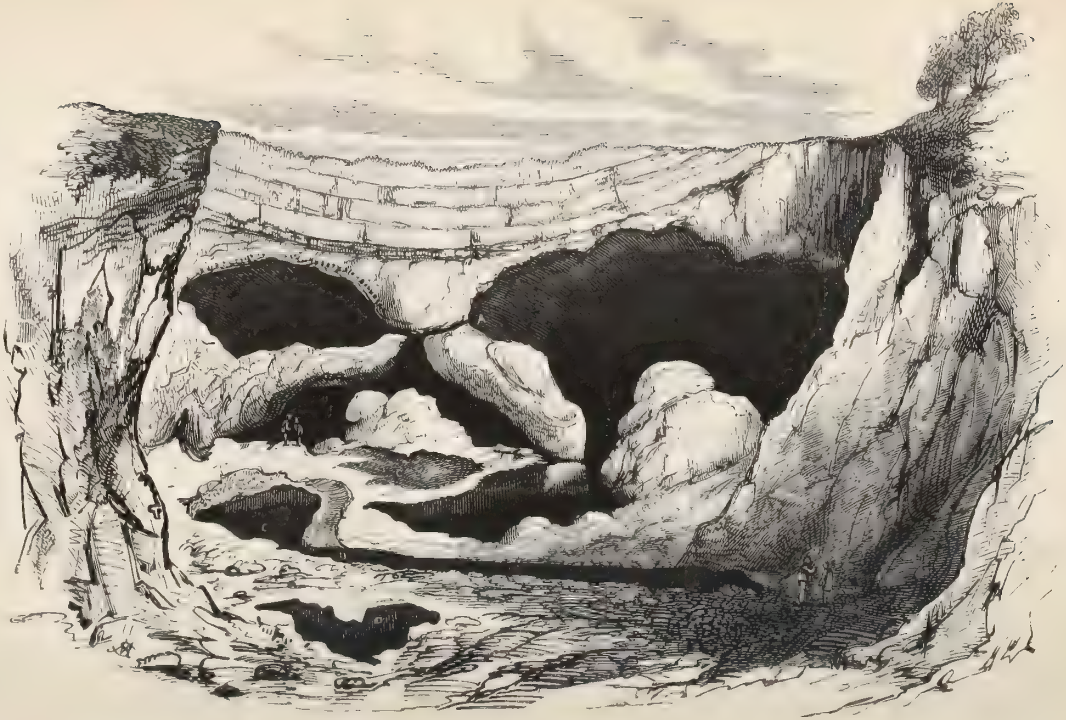
† Black Brush Ore.

with these ore-caverns, which are locally termed "churns,' there are some facts deserving special notice. Directly beneath the lowermost bed of the stratified rock, termed by the miners the "lidstone," the "crease" is traversed by a series of irregular joints or pipes, technically termed "leads," which rise out of the "churns," and often penetrate into the "lidstone," and even far beyond into the overlying rocks, coming out to the day. These "leads," when followed, usually increase in width, and then expand at the depth of a few feet—perhaps of only a few inches—into the churn-proper. The churns are not isolated pockets, but have strings or branches, more or less numerous, likewise termed "leads," which communicate with other churns lying either in the same plane, or in an inferior or superior one; hence the search for the ore is not of that precarious nature that it would have been had the "churns" been solitary, and not connected deposits. Experience has proved that the smaller the lead the larger generally is the "churn." The growth of the "mine-ground," to use a miner's expression, or the mode in which the ore is dispersed in the "churns," much resembles the conditions under which crystallized deposits of other minerals, such as carbonate of lime and sulphate of barytes, are often found in other caverns. The roofs of those churns which lie nearest to the lidstone are invariably encrusted with stalactitic ore, the crystallization apparently radiating towards the centre of the segments of the circles which are described by the irregular rolling form of the roof. In the dividing masses of "crease," geodes are exceedingly common, and concretions of compact hæmatite, lined with shining crystals of hydrous oxide of iron, are constantly detached from near the walls of the churns; the interior of the large churns, however, are mostly filled with powdery red hæmatite, held together by a slender frame-work of crystallized or compact ore, which trills easily before the pick, rendering the *getting* very inexpensive. In many of the old workings large quantities of the powdery ore or "Smith's Mine," which forms by far the richest product of the churns, have been found from time to time, having evidently been rejected by the old miners, who were probably unable to use it from its choking the furnace in the air bloomeries. The dimensions of the churns often exceed the belief of those who have not explored them, and few persons travelling over any of the roads near Mitcheldean, or from Bream to Lydney and Coleford, in fact, over nearly all sides of the Forest near the crop of the limestone, are aware that vast caverns exist beneath them, capable of accommodating the largest assemblies and presenting the most mystic and wonderful outlines. One of these old workings, or "weeldons," as they are locally termed, on Dean's Meend, near Mitcheldean, known as the "Sway Pole Mine Hole"—a name by no means worthy of its grand extent—may be visited without much difficulty by a little venturesome climbing, and its description will afford a good idea of the mode of occurrence of the churns, it being remembered that the passages and chambers have alone been formed by the excavation of the ironstone, none of the limestone or "crease," as is attested by the absence of any rubbish-heaps at the surface, having been removed. The entrance is by a deep precipitous but somewhat sloping pit, barely more than a yard in width. When the bottom of this is reached by the aid of a rope or ladder, the visitor stands within a small natural vestibule, on one side of which is a rude descending staircase, on the other a downright hole, the bottom of which has not been found. Lighting our candles, we proceed by the staircase—in which, however, there is an inconvenient irregularity in the size and order of the steps—down some twelve yards or so, and then enter a low horizontal winding gallery requiring a good deal of crawling on hands and knees to traverse it without a wounded head. Arrived at the end of this gallery, we can again stand up in a small chamber, from which several galleries lead off, but all of which wind back by various contorted paths to the staircase just passed. Stooping low, again, and taking the one path, we descend to an opening, the gloom of which, at first, the light of our candles seems unable to penetrate, but which, an assailing gust of cold air tells us, communicates by some pipe or channel with the surface above. A few seconds pass, and, by the feeble rays thrown before us, we see a steep, descending bank, covered with blocks of the "crease" of various sizes, which have evidently fallen from the roof, gazing up to which, other blocks, still impending and half-detached, make us wish the descent over, especially when the first foot that we set on these loose stones sends some of them thundering down, and we hear them leap, leap, leaping in the steep galleries below, until they seem to fall into some bottomless abyss. Down the steep slope, which we traverse altogether—and indeed to offer, here, precedence in going is to pay no compliment, with the stones rattling and bounding before us—until we reach a small worked-out churn, from which we issue by clambering over a huge block of detached rock, and then taking a small "lead," on the walls of which some portions of "Brush"-ore still remain, we crawl now into the "Wide road" or great "churn." The first thing that we see on raising our heads is a rude pyramidal heap of stones, which will prove very useful to us hereafter, as it forms our directing-post to the "Way out"—and without some such indicator it is more than probable we might contribute a future ossiferous interest to the caverns! Separating from each other, and holding our candles with upstretched arms into the vault above, we gather our first notion of the "Sway-pole Hole"—a notion which fills us with deepest wonder—which is even further heightened as we gaze backwards and forwards along a vault where the roof and walls are dimly discernable, and where

> "Beyond is all abyss,
> Whose end no eye can reach."

The dimensions of this "churn," however, are about 350 yards long, by an average height of 14 yards, and 12 yards in breadth; and, considering that it must have been filled with ore, which alone has been removed, its cubic contents, on the calculation of one ton to the cubic yard, equal nearly 60,000 tons, without including any branch-"churns" or "pockets," which would probably raise the quantity to 100,000 tons. This "churn" follows the direction of the strike, but pitches across the "bed" at the rate of about six inches in a yard; the dip of the measures is about one in three. Below, following the dip, there are other churns of great magnitude, but their size diminishes with their depth from the surface; indeed, the largest deposits of ore would seem to have been formed near to the crop of the measures, and it is yet an undetermined question whether "in the deep" the measures "make themselves," to use a mining term, as strongly as "in the land":—certain it is that the deep mines have not yet revealed any deposits to compare either in magnitude or productiveness with such churns as the one I have just described.

The accompanying sketch (Pl. VIII.) represents some partly emptied churns, laid open by excavation to the light of day, which I am working at Old Park, near Bream, and which will illustrate the relationship of the overlying stratified rock and the un-stratified "crease," showing at the same time the "leads" and general structure of the deposits. The mystical appearance of the entrances to the excavations and the solitude



THE DEVIL'S CHAPEL, OLD PARK IRON MINES, NEAR BREAM, FOREST OF DEAN.

of the spot, situated in the midst of a thickly-planted wood, has obtained for the locality the name of the "Devil's Chapel."

In many of the worked-out "churns," or "weeldons," there are considerable recent encrustations of carbonate of lime; and the natural process of forming stalactites and stalagmites may be seen in operation, although nothing has yet been produced to compare, in picturesque beauty, with the strange forms which are met with in our more famous limestone caves. The extreme slowness of the progress made in the formation of these encrustations is well demonstrated in the Sway-pole Mine, where the water holding the carbonate of lime in solution, drops equally on the floor of the churn and on the wall of a "brattice" or stopping erected in connexion with the former ventilation of the mine, at a period far beyond the memories, and even the traditions, of the oldest miners living in the district. A considerable thickness of stalagmite has formed on the floor, but on the wall of the brattice only a mere film of encrustation can be seen. Near the bottom of the "mine-measures," and following a general parallelism with the floor of the deposit in most of the mines on the south side of the Forest, a small irregular vein of reddle is to be traced, but which may, as it contains a large portion of alumina, be classed as an ochre. In shade it varies from a pale blood red to a rich madder brown, and is occasionally sufficiently intense in colour to rival the finest Armenian bole: it is exported from the Forest under the term "native red," and several hundred pounds' worth have been occasionally raised in a very short space of time from the same mine. The vein is known as the "Colour Spirt," and it was formerly a saying in the district that no "mine," meaning ore, existed below it. This, however, like other empirical dogmas, such as no copper west of Truro Bridge, in Cornwall, no coal beneath the Magnesian limestone in the north of England, &c., experience has proved to be false; and in certain large joints, which cut across the limestone bed, or under-edge-stone, that underlies the "mine-measures," large deposits of brush ore are found occupying a position in the joint nearly akin to the phenomena presented in a true "lode"; moreover, the upper portion of these joints, where they are near the surface, are filled with a highly ferruginous marl, already described as "clod-ore," which is so loaded with small particles of compact hæmatite as to occasionally show, by analysis, as much as 40 per cent. of iron. These joints have been proved at Bream to a depth of forty yards and upwards; they run at irregular distances apart, but have a constant bearing of 30° to 40° east of north, and in no case do they continue into the overlying "crease" of the "mine-measures" proper. The breadth of the joints is often nine and twelve feet, but varying, widening, and then "nipping-in." In connection with the Forest mine-measures, it is interesting to turn to those great deposits of ironstone which are formed in the Carboniferous limestone of the north of England. At Whitehaven the hæmatite occurs in deposits of irregular dimensions, forming dense masses subdivided by vertical joints, but which do not observe any parallelism. Botryoidal forms of the ore, accompanied by crystallized calcareous minerals, are formed in cavities. Limestone forms the roof, and shales, interbedded with ore, bound the deposit in depth. No satisfactory conclusion as to the origin of these deposits has yet been arrived at; but the ore most probably occupies cavernous spaces which were produced in the limestone—which differs from the Forest "crease" in being "bedded"—by contraction and subsequent water erosion. These hæmatites yield 60 per cent. of per-oxide of iron, united with from 5 to 6 per cent. of silica, and with minute quantities of alumina, lime, magnesia, and occasionally manganese. By referring to the section, page 267, it will be seen that a deposit of ironstone occurs in the lowermost division of the Millstone Grit. This deposit, which is known as the "sandstone-vein," does not "make itself" with the same regularity as the "ironstone-mine," nor is it of the same practical importance, since although the ore is, on the average, of a richer quality, the churns are never of the same magnitude. The whole thickness of the bed through which the churns run seldom exceeds five feet; but, as yet, this vein has been explored only to a very small extent, and it is more than possible that its economic pretensions will rise when it comes to be further worked. In nearly all respects the churns of the "sandstone-vein" agree in their general structure, and in the mode in which they are filled, with the deposits in the limestone; but it is more easy, in their case, to become convinced of the real contemporaneity of the ore with the containing rock, than in the case of the "limestone-vein."

The origin and mode of formation of the "iron-measures" in the Forest of Dean is certainly involved in much obscurity, occurring as they do, in the case of the limestone deposits, in an unstratified bed between stratified rocks. There is doubtless, however, in the cause of this, much to be traced to that which is mechanical, and still more to that which is purely chemical. The "mine-measures" may have been the result of a rapidly-accumulated calcareous silt, afterwards so altered by contraction and upheaval, as to have had all evidence of lamination and bedding obliterated; and, from being fissured during elevatory movements, may have become gradually cavernous by the mechanical and solvent powers of water. Into these fissures and hollows water saturated with carbonic acid, and holding proto-carbonate of iron in solution, may have deposited the iron by a gradual escape of part of the carbonic acid, in the same way as in the case of calcareous "sinter," when, by the admission of oxygen, it would soon become per-oxidised. Bischoff has shown that oxide of iron may be deposited in cavities, to which air has access, in globular and reniform masses having the greatest resemblance to brown hæmatite, from springs of a temperature of about 91° Fahr., and in connection with the upheaval of the "crease"-bed by subterraneous forces, it is more than probable that hot springs may have been produced; indeed, it is interesting to know that such phenomena are not even now wholly absent, and that springs, of a considerably higher temperature than that of water usually met with in not very deep mines, are still encountered in working the "churns." Should we assume the contemporaneity of the ore with the enveloping "crease," the investigation of the formation becomes of the highest interest in connection with the Paragenesis of minerals.[*] But be the origin of these deposits what it may, there can be no doubt but that subsequent chemical agencies causing segregation and re-arrangement of particles, have largely contributed to the condition in which the ore is now found.

The iron mines are worked by sinking a shaft down through the ore-measures to the "under-stone" in the deepest point of the "award," or, if the nature of the surface admits of such an arrangement, by driving a level in from a valley, so as to intersect the measures as they rise from the centre of the basin. When the churns are reached, "deep-headings" are driven out right and left along the line of "strike" of the bed, and other roads are then driven out at right angles to these main roads against the "dip," or "in the land." From these "land-headings" or "stall-roads," stalls are turned, *i.e.*, excavations are made at certain intervals along the land-headings, and parallel with the dip-headings, from which the ore is extracted. The annexed cut represents the method of "pillar and stall" working, as this mode of mining is termed.

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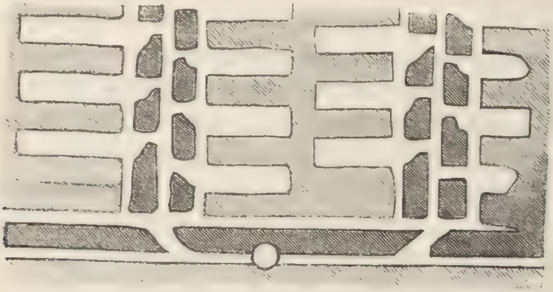
[*] The Paragenesis of Minerals (from a Greek verb signifying to be present with *παραγίγνομαι*) or the co-existence and mode of association of mineral bodies, is a matter well-deserving of special study, and destined to throw much light on the history of chemically-formed rocks, and particularly of mineral veins.—J. J. W. W.



Lign. 5.—Example of "Pillar and Stall" working.

The dark shading shows the buttresses allowed to stand for the support of the roof and maintenance of the ways. The lightly-shaded parts show the ore-ground which is being gradually worked away by the enlargement of the "stalls" represented by the blank spaces.

But the majority of the workings in the Dean Forest mines exhibit little of this regularity; since, after the dip-headings are driven, the churns are followed in all their irregularities of form, as seen in the sketch of the Devil's Chapel (Pl. VIII.) in which the darkly-shaded portions show the "churns" from which the ore has been removed. The dark line A is a "lead." At C, C, are seen small masses of ore *in situ*. The "crease" is displayed in the separating buttresses. B, in the foreground, is a "drift" driven across the "measures." D represents an opening made on a "lead." The number of mines at present in work in the Forest amounts to about twenty, commanding some 3,500 acres of ironstone, and, if continually exploited, at an average yield of 1,000 tons per day, would make the quantity raised equal to a rate of 300,000 tons per annum; the "get," however, is much less than this.

The length to which this paper has already extended warns me now to conclude, otherwise, I had intended to have introduced some account of the regulations attending the granting of "gales" or mining-awards in the Forest of Dean by the Crown. I will, however, return to this subject when describing the coal-measures of the district.

BRITISH FOSSILS, STRATIGRAPHICALLY ARRANGED.

By John Morris, F.G.S.

I. PALÆOZOIC SYSTEM.

(*Continued from page* 238.)

FOSSILS OF THE UPPER SILURIAN.

Echinodermata.

Cystidea.

- Apiocystites pentremitoides, *Forbes*, Sil. 245.
- Echinoencrinus armatus, *Forbes*, Sil. 245.
  - baccatus, *Forbes*, Sil. 245.
- Prunocystites Fletcheri, *Forbes*, Sil. 245.
- Pseudocrinus bifasciatus, *Pearce*, M. G. S. 2. 496.
  - magnificus, *Forbes*, Sil. 245.
  - oblongus, *Forbes*, M. G. S. 2. 499.
  - quadrifasciatus, *Pearce*, Sil. 245.
- Tetragonis Danbyi, *M'Coy*, P. F. 62.

Crinoidea.

- Actinocrinus arthriticus, *Phil.* S. S. 674.
  - pulcher, *Salter*, P. F. 55.
  - simplex, *Phil.* S. S. 673.
  - (*Cyathocrinus tesseracontadactylus*, Sil. 246.)
  - retiarius, *Phil.* S. S 674.
- Cophinus dubius, *Murch*, S. S. 697.
- Crotalocrinus rugosus, *Mill. sp.* Sil. 247.
- Cyathocrinus capillaris, *Phil.* S. S. 671.
  - goniodactylus, *Phil.* S. S. 671.
  - Orbignii, *M'Coy*, P. F. p. 53
  - tuberculatus, *Goldf.* Pet. 1. 190
  - macrostylus, *Phil.* M. G. S. 2. 384.
- Dimerocrinus decadactylus, *Phil.* S. S. 674.
  - icosidactylus, *Phil.* S S. 674
- Enallocrinus punctatus, *His. sp.* Leth. Suec. p. 89.
- Eucalyptocrinus (*Hypanthocrinus*).
  - decorus, *Phil.* S. S. p. 672
  - granulatus, *Lewis*, Lond. Geol Jour., p. 99.
- Eucalyptocrinus polydactylus, *M Coy*, P. F. 58.
- Ichthyocrinus pyriformis, *Phil. sp.* S. S. 672.
- Marsupiocrinus cælatus, *Phil.* S. S. 672.
- Periechocrinus articulosus, *Aust.* A. N. H. 1843. p. 204.
  - moniliformis, *Mill. sp.* S. S. 672
- Pisocrinus ornatus, *Koninck*, 'Geologist,' i. p 184.
  - pilula, *Koninck*, *ibid.* p. 184.
- Sagenocrinus expansus. *Phil. sp.* S. S. 674.
  - giganteus, *Aust.* A. N. H. 1843. 205.
- Tetramerocrinus formosus, *Aust.* A. N. H. 1843. p 203.

Asteriadæ.

- Palæaster Ruthveni, *Forbes*, Sil. 249.
- Palasterina hirudo, *Forbes*, Sil. 249.
  - primæva, *Forbes*, Sil. 249.
- Palæocoma cygnipes, *Salt.* A. N. H. 20. 330.
  - Colvinii, *Salt.* Sil. 141.
  - Marstoni, *Salt.* Sil. 141.
  - vermiformis, *Salt.* A. N. H. 20. p. 330.
  - pyrotechnica, *Salt.* A. N. H. 20. p. 330.
- Lepidaster Grayii, *Forbes*, Dec. 3. t. 1.

Ophiuridæ.

- Palæodiscus ferox, *Salt.* A. N. H. 20. p. 330.
- Protaster leptosoma, *Salt.* A.N.H. 20. 330.
  - Miltoni, *Salt.* A. N. H. 20. 330.
  - Sedgwickii, *Forbes*, Dec. 1. t. 4.

Echinidæ.

- Palæchinus Phillipsiæ, *Forbes*, Mem. Geol. Surv 2. 384.

Annelida.

- Cornulites serpularius, *Schl.* S. S. 627.
- Serpulites curtus, *Salt.* M. G. S. 2. p. 333.
  - dispar, *Salt.* P. F. Ap. p. 1.
  - longissimus, *Murch.* S. S. 700.
- Serpulites perversus, *M'Coy*, G. J. 9, p. 15.
- Tentaculites ornatus, *Sow.* S. S. 628.
  - tenuis, *Sow.* S. S. 613.
- Trachyderma coriaceum, *Phil.* M. G. S. 2. 332.

Crustacea.

- Acidaspis Barrandii, *Fletcher*, Sil. 261.
    - Brightii, *Murch.* Sil. 261.
    - coronatus, *Salt.* G. J. 13. 211.
    - crenatus, *Emmrich*, *sp.*N. Jahrb. 1845. p. 44
    - Dama, *Fletcher*, MS.
    - dumetosus, *Fletcher*, MS.
    - quinquespinosus, *Fletch.* MS.
- Ampyx parvulus, *Forbes*, M. G. S. 2. 350.
- Bronteus laticauda, *Wahl. sp.* S. S. 17.
- Bumastus Barriensis, *Murch.* Sil. 123.
- Calymene Blumenbachii, *Brong.* C.F. 11.
    - tuberculosa, *Salt.* Sil. 260.
- Cheirurus bimucronatus, *Murch.* Sil. 260.
- Cyphaspis megalops, *M'Coy*, Sil. 261.
- Deiphon Forbesi, *Barr.* S. S. Boh. 814.
- Encrinurus punctatus, *Brünn.* Sil. 261.
    - variolaris, *Brong.* Sil. 261.
- Homalonotus delphinocephalus, *Green*, Sil. Syst. p. 651.
    - Knightii, *König.* Ic. Fos. 65.
- Lichas Anglicus, *Beyr.* Sil. 260.
    - Barrandii, *Fletch.* Sil. 260.
    - Grayii, *Fletch.* G. J. 6. 237.
    - hirsutus, *Fletch.* G. J. 6. 236.
    - nodulosus, *Salter*, P. F. 151.
    - Salteri, *Fletch.* G. J. 6. 237.
- Phacops caudatus, *Brünn. sp.* S. S. 654.
- Phacops Downingiæ, *Murch.* Sil. 260.
    - Stokesii, *M. Edw. sp.* M. G. S. 2. 335. (*Calymene macrophthalma*, Sil. Syst.)
- Proetus latifrons, *M'Coy*, Sil. 261.
    - Ryckholti, *Barr.* S. S. Boh. 439.
    - Stokesii, *Murch.* Sil. 261.
- Sphærexochus mirus, *Barr.* Sil. 261.
- Beyrichia Kloedeni, *M'Coy*, Sil. 260.
    - siliqua, *Jones*, A. N. H. 16, 90.
    - Wilckensiana, *Jones*, A. N. H. 16. 90.
- Ceratiocaris ellipticus, *M'Coy*, P. F. 137.
    - inornatus, *M'Coy*, P. F. 137.
    - solenoides, *M'Coy*, P. F. 138.
- Eurypterus cephalaspis, *Salter*, P. F. 175.
    - pygmæus, *Salt.* Sil. 266.
- Pterygotus (*Himantopterus*).
    - Banksii, *Salter*, Sil 266.
    - acuminatus, *Salt.* G. J. 12, 29.
    - bilobus, *Salt.* G. J. 12, 30.
    - lanceolatus, *Salt.* G. J. 12, 32.
    - maximus, *Salt.* G. J. 12, 29.
    - perornatus *Salt.* G. J. 12, 31.
    - punctatus, *Salt.* Sil. 140.
    - Parka decipiens, *Flem.*, Lyell, Man. Geol. p. 421 ; Page, Text-b. p. 127. Egg-packets?

Bryozoa.

- Ceriopora abnormis, *Lons. sp.* S. S. 693.
    - affinis, *Goldf.* Pet. 216.
    - granulosa, *Goldf.* Pet 217.
    - punctata, *Goldf.* Pet. 217.
- Diastopora irregularis, *Lons.* S. S. 679.
- Discopora antiqua, *Lam.* S. S. 679.
    - favosa, *Lons.* S. S. *Lons.* S. S. 679.
    - squamata, *Lons.* S. S. 679.
- Escharina angularis, *Lons.* S. S. 676.
- Fenestella asimilis, *Lons.* Sil. 239.
    - Lonsdalei, *d'Orb.* Sil. 239.
    - Milleri, *Lons.* S. S. 678.
    - reticulata, *Lons.* S. S. 673.
    - subantiqua, *d'Orb.* Sil. 203.
- Glauconoma disticha, *Goldf.* Sil. 239.
- Polypora crassa, *Lons.* Sil. 239.
- Ptilodictya lanceolata, *Goldf.* Sil. 239.
    - scalpellum, *Lons.* Sil. 239.

Brachiopoda.

- Athyris circe, *Barrande*, Sil. 251.
    - compressa, *Sow. sp.* S. S. 629.
    - didyma, *Dalm.* S. S. 614.
    - navicula, *Sow. sp.* S. S. 611.
    - obovata, *Sow. sp.* S. S. 618.
    - tumida, *Dalm. sp.* Vet. Ac. t. 5.
- Atrypa crassa, *Sow.* S. S. 636.
    - hemisphærica, *Sow.* S. S. 637.
    - marginalis, *Dalm.* Vet. Ac. 59.
    - orbicularis, *Sow.* S. S. 637.
    - reticularis, *Linn. sp.*S. S. 614.
    - ? cuneata, *Dalm.* S. S. 625.
- Chonetes striatella, *Dalm. sp.* L. Suec. 70.
- Crania craniolaris, *M'Coy*, P. F. 255.
- Crania Sedgwickii, *Dav.* Bul. S. G. Fr. 5. 334.
- Discina Forbesii, *Dav.* Sil. 250.
    - implicata, *sp. Sow.* S. S. 625.
    - Morrisii, *Dav.* Bul. S. G. Fr. 5. 334.
    - rugata, *Sow.* S. S. 610
    - striata, *Sow.* S. S. 610.
    - Verneuilli, *Dav.* B. S. G. Fr. 5. 334.
- Leptæna Fletcheri, *Dav.* Bul. S. G. Fr. 5. 319.
    - lævigata, *Sow.* S. S. 629.
    - oblonga, *Pander*, Geol. Russ. p. 228
    - Orbignii, *Dav.* Bul. S G. Fr. 5 320.
    - sericea, *Sow.* S. S. 636.
    - transversalis, *Dalm.* S. S. 639.

- Lingula cornea, *Sow.* S. S. 603.
  - crumena, *Phil.* M. G. S. 2. 369.
  - lata, *Sow.* S. S. 618.
  - Lewisii, *Sow.* S. S. 615.
  - parallela, *Phil.* M. G. S. 2. p. 370.
  - striata, *Sow.* S. S. 619.
  - Symondsi, *Murch.* Sil. 252.
- Obolus Davidsoni, *Salter*, Dav. Brach. 136.
  - transversa, *Salter*, Dav. Brach. 136.
- Orthis æquivalvis, *Dav.* Bul. G. S. Fr. 5. p. 321.
  - biforatus, *Schlot.* Sil. 210.
  - Bouchardii, *Dav.* Sil. 251.
  - calligramma, *Dalm.* Sil. 251.
  - Davidsoni, *Vern.* Bul. S. G. Fr. 5. 323.
  - elegantula, *Dalm.* Leth. Succ. 77.
  - hybrida, *Sow.* S S. 630.
  - Lewisii, *Dav.* Bul. S. G. Fr. 5. 309.
  - lunata, *Sow.* S. S. 611.
  - porcata, *M'Coy*, G. F. 223.
  - rustica, *Sow.* S. S. 624.
- Pentamerus galeatus, *Dalm. sp.* S. S. 618.
  - linguifer, *Sow. sp.* S. S. 629.
  - liratus, *Sow. sp.* Sil. 100.
  - Knightii, *Sow.* M. C. t. 28.
- Retzia Bouchardii, *Dav.* Sil. 250.
  - Salteri, *Dav.* Sil. 250.
- Rhynchonella borealis, *Schlot.* M. G. S. 2. 383.
  - (*Ter. lacunosa*, Sil. Syst.)
  - Barrandii, *Dav.* Sil. 250.
- Rhynchonella, brevirostrum, *Sow.* S. S. 631.
  - Capewelli, *Dav.* Sil. 250
  - crispata, *Sow.* S. S. 624.
  - Davidsoni, *M'Coy*, P. F. 200
  - depressa, *Sow.* S. S. 629.
  - Grayi, *Dav.* Sil. 250.
  - interplicata, *Sow.* S. S. 631.
  - Lewisii, *Dav.* Sil. 250.
  - nitida, *Hall*, B. S. G. Fr. 5. 327.
  - nucula, *Sow.* Sil. 250.
  - rotunda, *Sow.* S. S. 629.
  - sphæroidalis, *M'Coy*, P. F. 203.
  - Stricklandi, *Sow.* S. S. 631.
  - Wilsoni, *Sow.* M. C. t. 118.
- Siphonotreta Anglica, *Morris*, Sil. 250.
- Spirifer crispus, *Linn.* S. S. 624.
  - elevatula, *Dalm.* Leth. Succ. 73.
  - picatellus, *Linn. sp.* (*Cyrtæna*).
  - (*S. radiatus, interlineatus,*) S. S. 614.
  - trapezoidalis, *Dalm.* S. S. 610.
  - pisum, *Sow.* S. S. 630.
- Strophomena antiquata, *Sow.* Sil. 251.
  - applanata, *Salt.* S. F. 72.
  - compressa, *Sow.* S. S. 638.
  - depressa, *Sow.* M. C. t. 459.
  - euglypha, *Sow.* S. S. 622.
  - filosa, *Sow. sp.* S. S. 630.
  - funiculata, *M'Coy*, Sil. 251.
  - imbrex, *Pander*, Sil. 251.
  - Ouralensis, *Vern.* Geol. Rus. 220
  - pecten, *Linn. sp.* Sil. 251.
  - Waltonii, *Dav.* Bul. S. G. Fr. 5. 317.

LAMELLIBRANCHIATA (Monomyaria).

- Ambonychia acuticosta, *M'Coy*, P. F. 265.
- Avicula ampliata, *Phil.* M.G.S. 2, 367.
  - Danbyi, *M'Coy*, P. F. 258.
  - mira, *Barrande*, Sil. 253.
- Pterinea asperula, *M'Coy*, Sil. 253.
  - Boydii, *M'Coy*, P. F. 259.
  - demissa, *Conrad.* Jour. Ac. Phil. 8.
  - lineatula, *d'Orb*, Prod. 23.
- Pterinea hians, *M'Coy*, P. F. 260.
  - planulata, *Conrad*, Sil. 253.
  - pleuroptera, *M'Coy*, P. F. 261.
  - reticulata, *His.* Leth. Suec. 57.
  - retroflexa, *Wahl.* S. S. 609.
  - Sowerbii, *M'Coy*, P. F. 263.
  - subfalcata, *M'Coy*, P. F. 263.
  - tenuistriata, *M'Coy*, Sil 258.
  - rectangularis, *Sow.* S. S. 603.

LAMELLIBRANCHIATA (Dimyaria).

- Anodontopsis angustifrons, *M'Coy*, P. F. 271.
  - bulla, *M'Coy*, P. F. 271.
  - lævis, *Sow. sp.* P. F. 271.
  - quadratus, *M'Coy* P. F. 272.
  - securiformis, *M'Coy*, P. F. 272.
- Arca Eastnori, *Sow.* S. S. 635.
- Nucula Anglica, *d'Orb.* Prod. 33.
  - Edmondiiformis, *M'Coy*, P. F. 283.
  - primitiva, *Phil.* M. S. G. 2. 366.
  - subæqualis, *M'Coy*, P. F. 283.
  - deltoidea, *Phil.* M. G. S. 2, 369.
- Nucula levata, *Hall*, P. N. Y. 1. 150
  - lingualis, *Phil.* M. G. S. 2, 367.
  - rhomboidea, *Phil.* M. G. S. 2, 367.
  - poststriata, *M'Coy*, P. F. 286.
- Cardiola fibrosa, *Sow.* S. S. 617.
  - interrupta, *Sow.* S. S. 617.
- Cleidophorus planulatus, *Conrad.* P. F. 273.
  - ovalis, *M'Coy*, P. F. 273.
- Cucullella antiqua, *Sow*, S. S. 602.
  - Cawdori, *Sow.* S. S. 602.
  - coarctata, *Phil. sp.* M. G. S. 2, 366.

Cucullella ovata, *Sow.* S. S. 602.
Pleurorhynchus æquicostatus, *Phil.* Mem. Geol. Surv. 2, p. 359.
Dolabra elliptica, *M'Coy*, P. F. 269.
obtusa, *M'Coy*, P. F. 270.
Grammysia extrasulcata, *Salter*, Mem. Geol. Surv. 2, p. 361.
cingulata, *His. sp.* Sil. 254.
rotundata, *M'Coy*, P. F. 281.
triangulata, *Salt.* Sil. 254.
Leptodomus globulosus, *M'Coy.* P. F. 278.
Lyrodesma cuneata, *Phil. sp.* Mem. Geol. Surv. 2, p. 366.
Goniophora cymbæformis, *Sow.* Sil. 253.
Modiolopsis antiquus, *Sow.* S. S.
complanata, *Sow.* Sil. 253.
Nilssoni, *His.* Sil. 254.
perovalis, *Salt.* M. G. S. 2, 363.
quadratus, *Salt.* M. G. S. 2. 363.
Modiolopsis platyphyllus, *Salt.* Sil. 254.
solenoides, *Sow.* P. F. 269.
Mytilus exasperatus, *Phil.* M. G. S. 2. 364.
mytilimeris, *Conrad*, Sil. 254.
Chemungensis, *Conrad, sp.* Jour. A. N. S. Phil. 8. Pl. 20. p. 10, 11.
? unguiculatus, *Salt.* M. G. S. 2, 365.
Orthonota amygdalina, *Sow.* Sil. 254.
impressa, *Sow.* Sil. 254.
prora, *Salter*, Sil. 254.
retusa, *Sow.* Sil. 254.
angulifera, *M'Coy*, Sil. 254.
rigida, *Sow.* Sil. 254.
solenoides, *Sow.* Sil. 254.
semisulcata, *M'Coy*, P. F. p. 275.
inornata, *Sow.* M. G. S. 2. 362.
undata, *Sow.* Sil. 254.
Tellinites affinis, *M'Coy*, P. F. 286.

Gasteropoda.

Capulus (*Acroculia, sp*).
euomphaloides, *M'Coy.* P. F. 290.
? Haliotis, *Sow. sp.* S. S. 625.
? prototypa, *Phil. sp.* M. G. S. 2. 358.
Chiton Grayanus, *Koninck*, Bull. Ac. Roy. Brux. 2. ser. 3. p. 199.
Wrightianus, *Koninck*, *ib.* 199.
Euomphalus alatus, His. Let. Succ. 36.
carinatus, *Sow.* S. S. 616.
discors, *Sow.* M. C. t. 52.
funatus, *Sow.* M. C. t. 450.
sculptus, *Sow.* S. S. 626.
rugosus, *Sow.* M. C. t. 52.
lautus, *M'Coy*, S. F. p. 14.
tricinctus, *M'Coy*, S. F. 14.
Holopella cancellata, *Sow.* S. S. 642.
conica, *Sow.* S. S. 604.
gracilior, *M'Coy*, P. F. 303.
gregaria, *Sow. sp.* P. F. 303.
intermedia, *M'Coy*, P. F. 304.
Holopella obsoleta, *Sow.* S. S. 603.
Littorina undifera, *M'Coy*, P. F. 306.
Loxonema elegans, *M'Coy*, P. F. 302.
sinuosa, *Sow.* S.S. 619.
Murchisonia articulata, *Sow.* Sil. 257.
cingulata, *His. sp.* Let. Succ. 39.
corallii, *Sow.* S. S. 612.
Lloydii, *Sow.* S. S. 619.
torquata, *M'Coy*, P. F. 294.
Natica parva, *Sow.* S. S. 612.
Pleurotomaria balteata, *Phil.* M. G. S. 2. 358.
crenulata, *M'Coy*, P. F. 291.
undata, *Sow.* S. S. 619.
Trochus cælatulus, *M'Coy*, P. F. 296.
? helicites, *Sow.* Sil. 256.
Turbo cirrhosus, *Sow.* Sil. 256.
corallii, *Sow.* S. S. 612.
octavia, *d'Orb.* Prod. p. 30.
Williamsi, *Sow.* Sil. 256.

Pteropoda.

Conularia Sowerbii, *Defrance*, (*C. quadrisulcata*), S. S. 626.
subtilis, *Salter*, P. F. 288.
Cyrtolites lævis, *Sow.* Sil. 257.
Theca anceps, *Salt.* M. G. S. 2. 355.
Forbesii, *Sharpe*, G. J. 2. 314.

Heteropoda.

Bellerophon expansus, *Sow.* S. S. 613.
carinatus, *Sow.* Sil. 257.
dilatatus, *Sow.* Sil. 257.
Bellerophon Murchisonii, *d'Orb.* Sil. 257.
trilobatus, *Sow.* Sil. 257.
Wenlockensis, *Sow.* Sil. 257.

Cephalopoda.

Ascoceras Barrandii, *Salt.* Sil. 259.
Actinoceras Brightii, *Sow.* S. S. 626.
? nummularium, *Sow.* S. S. 632.
Phragmoceras arcuatum, *Sow.* S. S. 621.
compressum, *Sow.* S. S. p. 621.

Phragmoceras intermedium, *M'Coy*, P. F. 322.
  nautileum, *Sow*. Sil. 258.
  pyriforme, *Sow*. Sil. 258.
  ventricosum, *Sow*. Sil. 258.
Lituites articulatus, *Sow*. S. S. 622.
  Biddulphii, *Sow*. S. S. 626.
  giganteus, *Sow*. Sil. 259.
  tortuosus, *Sow*. S. S. 626.
Orthoceras annulatum, *Sow*, M. C. t. 133.
  angulatum, *Wahl*. Sil. 258.
  articulatum, *Sow*. S. S. 613.
  attenuatum, *Sow*. S. S. 632.
  bullatum, *Sow*. Sil. 258.
  canaliculatum, *Sow*. Sil. 258.
  centrale, *His*. Let. Suec. 29.
  circulare, *Sow*. M. C. 29.
  conicum, *His*. Let. Succ. 29.
  dimidiatum, *Sow*. Sil. 258.
  distans, *Sow*. S. S. 619.
Orthoceras excentricum, *Sow*. S. S. 631.
  filosum, *Sow*. Sil. 258.
  fimbriatum, *Sow*. S. S. 620.
  gregareum, *Sow*. S. S. 616.
  imbricatum, *Wahl*. Sil. 258.
  ibex, *Sow*. Sil. 258.
  laqueatum, *Hall*, P. N. Y. 1. 13.
  Ludense, *Sow*. Sil. 258.
  Maclareni, *Salt*. Sil. 176.
  Mocktreense, *Sow*. S. S. 258.
  primævum, *Forbes*, Sil. 258.
  perelegans, *Salt*. M. G. S. 2. 354.
  semipartitum, *Sow*. S. S. 674.
  substriatum, *d'Orb*. Prod. 54.
  subundalatum, *Portl*. G. R. 373.
  subgregarium, *M'Coy*, S. F. p. 9.
  tenuiannulatum, *M'Coy*, P. F. 320.
  tenuicinctum, *Portl*. G. R. 371.
  tracheale, *Sow* S. S. 604.
  vertebrale, *Hall*, P. N. Y. 1. 201.

SEDIS INCERTÆ.

Ischadites Kœnigi, S. S. 697.
Spongarium æquistriatum, *M'Coy*, P. F. 42.
Spongarium Edwardsi, *Murch*. S. S. 696.
  interlineatum, *M'Coy*, P. F. 43.
  interruptum, *M'Coy*, P. F. 43.

[*For the Fishes, see "Tilestones," p.* 286.]

WENLOCK GROUP.

LOCALITIES OF THE TARANNON SHALES.

These rocks, which are sometimes shales, occasionally hard and slaty, and containing but few fossils, occupy an intermediate place between the Llandovery beds and the overlying Denbigh grits and shales. Near Llandovery; New Bridge and at Tarannon, between Llanbrynmaer and Llandiloes, in Montgomeryshire.

Localities of Denbigh Rocks.—These beds consist of sandstones, grits, shales, and flagstones, usually presenting a slaty cleavage. Marloes Bay, Pembrokeshire; near Bala, near Llanbister, Radnorshire; Berwyns, Denbighshire. The fossils are chiefly Wenlock species, Chonetes lata, Spirifer trapezoidalis, Cucullella ovata, Murchisonia Lloydii, Bellerophon carinatus, Arthoceras annulatum.

Localities of Woolhope Limestones.—A variable deposit of grey limestone, either thick-bedded or nodular, and subordinate to beds of shale. This bed and the Denbigh grits are considered by Sir R. Murchison to be simply lithological varieties of the lower portion of the Wenlock formation (Siluria, p. 116). Corton, near Presteign, Nash Scar, Old Radnor, Woolhope, Hayhead, near Walsall, Colmer's End.

Fossils.—Orbicula Forbesi, Strophomena imbrex, S. pecten, Spirifer elevatus, S. trapezoidalis, Euomphalus sculptus, Orthoceras annulatum, Cornulites serpularius, Bumastus Barriensis, Homalonotus delphinocephalus.

Localities of Wenlock Shales.—Malvern and Woolhope districts; Apesdale, escarpment of Wenlock Edge; banks of the Severn, near Coalbrook Dale.

Fossils.—Cyathophyllum turbinatum, Favosites alveolaris, Stenopora fibrosa, Obolus transversus, Athyris tumida, Leptæna lævigata, L. transversalis, Orthis biloba, O. hybrida, O. rustica, Pentamerus linguifer, Rhynchonella deflexa, R. depressa, R. sphærica, Modiola antiqua, Mytilus exasperatus, M. mytilimeris, Capulus haliotes, Turbo cirrhosus, Bellerophon dilatatus, Lituites Biddulphi, L. articulatus, Orthoceras subundalatum, O. primævum, Calymene tuberculosa, Encrinurus punctatus, E. variolaris, Phacops caudatus.

Localities of Wenlock Limestone.—Wenlock and Benthall Edge, Gliddon Hill, Dudley, Malvern, May Hill, Usk, Woolhope districts.

Fossils, Corals.—Favosites Gythlandicus, &c., Halysites catenulatus, Heliolites insterstinctus, Stenopora fibrosa, Omphyma turbinata.

Shells.—Atrypa reticularis, Retzia cuneata, Rhynchonella borealis, R. nucula, Leptæna transversalis, Orthis rustica, O. elegantula, Spirifer plicatilis, Strophomena euglypha, S. depressa, Avicula reticulata, Pterinea planulata, P. retroflexa, Euomphalus rugosus, E. funatus, Bellerophon Wenlockensis, Conularia Sowerbii, Orthoceras annulatum, O. Brightii.

Trilobites.—Calymene Blumenbachii, Encrinurus variolaris, E. punctatus, Phacops Downingiæ, P. caudatus, P. Stokesii.

LUDLOW GROUP.

The upper and lower Ludlow rocks consist of sandstones, shales, and mudstones, separated in some localities by an intermediate grey, argillaceous shale and a nodular calcareous band—the Aymestry limestone.

Localities of Lower Ludlow.—Woolhope and Malvern districts; Ledbury, near Eastnor Castle, Mary Knoll Dingle, Ludlow; Park lane, Llandeilo; Leintwardine, Shropshire.

Characteristic Fossils.—Lingula lata, Strophomena euglypha, Leptæna levigata, Cardiola interrupta, C. striata, Ctenodonta sulcata, Cucullella coarctata, Orthonota rigida, O. solenoides, Lituites giganteus, Orthoceras Ludense, O. filosum, Phragmoceras pyriforme, P. ventricosum, P. arcuatum, Murchisonia Lloydii, Pleurotomaria caudata, Palæocoma Marstoni, P. Colvini, Protaster Miltoni, Pterygotus punctatus.

Localities of Aymestry limestone.—Ledbury, Frith Wood, Malvern district; Whiteway Head, Aymestry; Lye Waste, Sedgley; Woolhope and Ludlow; Usk, Monmouthshire.

Characteristic fossils.—Pentamerus Knightii, Rhynchonella Wilsoni, R. navicula, Atrypa reticularis, Lingula Lewisii, Strophomena euglypha, Leptæna lævigata, Pterinea Sowerbyi, P. hians, Orthonota rotundata, Murchisonia cingulata, Euomphalus carinatus, Orthoceras Mocktreense.

Localities of the Upper Ludlow.—Ledbury, Frith Wood, Mathon court, Malvern district. Ludlow, near Kington; Abberley hill; west flank of May Hill; Presteign, Radnorshire; south of Builth, Brecknockshire; near Usk, Monmouthshire. Benson Knot, Kirkby Moor, Kendal, Underbarrow, Westmoreland.

Characteristic fossils. — Chonetes (Leptæna) lata, Orthis lunata, O. orbicularis, Orbicula rugata, Goniophora cymbæformis, Pterinea lineatula, P. retroflexa, P. tenuistriata, Nucula subæqualis, Grammysia cingulata, Orthonota amygdalina *(O. retusa)*, Modiolopsis complanata, M. solenoides, Avicula Danbyi, A. ampliata, Turbo corallii, T. undifer, Murchisonia corallii, Holopella gregaria, H. intermedia, Orthoceras angulatum, O. ibex, O. bullatum, Ascoceras Barrandii, Bellerophon expansus, Ceratiocaris solenoides, Proetus latifrons, Homalonotus Knightii, Pterygotus problematicus, Serpulites longissimus.

FOSSILS OF THE TILESTONES, &c.

Plantæ.

Actinophyllum plicatum, *Phil.* M. G. S. 2. p. 386.
Lycopodiaceæ, seeds of, *Hooker*, G. J. ix. 8.

Brachiopoda.

Lingula cornea, *Sow.* Sil. 156.

Gasteropoda.

Trochus helicites, *Sow.* .S S. 156.

Crustacea.

Beyrichia Kloedeni, *M'Coy*, P. F. 156.
Ceratiocaris, (*Leptocheles*) Murchisoni, *M'Coy*, Sil. 263.
Eurypterus acuminatus, *Salter*, G. J. (1858).
  abbreviatus, *Salt.* G. J. (1858).
  linearis, *Salter*, G. J. (1858).
  megalops, *Salter*, G. J. (1858).
  pygmæus, *Salter*, G. J. 12. p. 101.
Pterygotus (*Himantopterus*) acuminatus, *Salter*, G. J. 12. p. 29.
Pterygotus Anglicus, *Ag.* Sil. p. 155. (with *Parka decipiens* as the ova, *Salter*).
  Banksii, *Salt.* G. J. 12. p. 101.
  bilobus, *Salt.* G. J. 12. p. 30.
  gigas, *Salter*, G. J. 12. p. 30.
  lanceolatus, *Salt.* G. J. 12. p. 32.
  mascimus, *Salt.* G. J. 12. p. 29.
  perornatus, *Salt.* G. J. 12. p. 31.
Leperditia marginata ?, Keys. A. N. H. 17. 95.

FISHES.

- Auchenaspis Salteri, *Eg.* G. J. 13. 286.
- Cephalaspis Murchisoni, *Eg.* G. J. 13. 284.
  - ornatus, *Eg.* G. J. 13. 285.
- Onchus Murchisoni, *Ag.* S. S. 607. 703.
  - tenuistriatus, *Ag.* S. S. 607. 703.
    - (Shagreen of Onchus? Thelodus *Ag.* fide *Salter*).
- Plectrodus mirabilis, *Ag.* S. S. 606 704.
  - pustuliferus, *Ag.* S. S. 605.
- Pteraspis Banksii, *Huxley* and *Salter* Geol. Jour. 12. p. 100.
  - truncatus, *id.* G. J. 12. p. 100.
- Sphagodus, *Ag.* S. S. 606.

Localities of Tilestones and associated Rocks.—Kington, Ludford, near Ludlow, Bradnor Hill, Old Radnor, Hagley Park, Downton Castle, Tin Mill, Brockhill and Hales End, near Malvern, Hole Farm, Abberley, Terton, near Stoke Edith, Woolhope district, east of Llangadock. Lesmahago, Lanarkshire.

(*To be continued.*)

THE COMMON FOSSILS OF THE BRITISH ROCKS.

By S. J. Mackie, Esq., F.G.S., F.S.A., &c., &c.

CHAPTER III.

The Remnants of the First Life world and the Bottom Rocks.

(*Continued from page* 241.)

The divisional line of the "Bottom Rocks" is not, however, to be placed at the point at which life first appears. This great series is naturally divided by differences of mineral conditions, by order of deposition, and in reality of age, in our own country, and in other countries both of Europe and America, and apparently also, as far as our present information goes, in Asia and Africa.

In Canada, below the equivalents of our Shropshire "Bottom Rocks" and of our lower Cambrian beds, as in the Highlands of Scotland, as we have already obtained, are still more ancient beds of sedimentary origin, which have become crystalline. In Bohemia, in Finland, and in Scandinavia we have these primeval gneissic lands below the lowermost Silurian deposits; but the geologists generally of other countries, except the Canadian, have not yet made much progress in this investigation, and it is only in very few instances that the distinctions between the older and younger gneiss have been noticed; and so little regard as to geological age has been ordinarily paid in the case of granitic rocks, that, knowing as we do the very various periods at which some of those masses were erupted, or protruded through sedimentary strata, the mere knowledge of their existence is nearly or quite valueless as evidence.

The Canadian divisions of the "Bottom Rocks" have received the appellations of "Laurentian" and "Huronian."

For the knowledge of these and of the nature and sequence of the overlying rocks we are mainly indebted to Sir W. E. Logan, and we refer those of our readers who desire more detailed information of this subject, of which we give a resumé, to Sir William's reports on the geology of Canada, and to a little volume published about three years since in Paris, "Esquisse Géologique du Canada," by MM. Logan and Sterry Hunt.

The province of Canada is divided in its entire length by a mountainous tract which divides it into two basins. These mountains are known as the Laurentines — and hence the first appellation— from the northern bank of the river St. Lawrence, from the Gulf to Cape Torment, near Quebec, from which point, gradually diverging from the course of the stream, they form, in their range westward, the high land along the line of Outaouais, and pass near Cat Lake, at about one hundred and fifty miles from Montreal. Taking a southernly direction, they regain the St. Lawrence near the discharge of the Lake Ontario, and thence run to the north-west; the south-eastern extremity of this range being attained at Lake Huron, of which it forms the eastern margin up to the 47th degree of latitude. Quitting the lakes, the range extends in a north-westward direction to the Arctic Sea.

These rocks, for the most part gneissic or hornblendic schists, are the oldest in America, corresponding to the Scandinavian gneiss and the similar rocks of the North of Scotland, and attain in this vast range a height of 2,500 to 3,000 feet or more. They are, without exception, ancient sedimentary deposits, which have become highly crystalline, and have been subjected to great disturbances; the general direction of the mountain ranges being N.E. and S.W.

The shores of Lakes Huron and Superior offer a series of schists, limestones, and conglomerates, intercalated with which are thick masses of diorite, reposing unconformably upon the rock-masses of the Laurentian formation. These rocks—called from their typical development in this region "the Huronian"—are inferior to, or below the Silurian formation; but as yet no fossils have been discovered in them. However, from their position and analogies, they must be associated with the equivalents of our "Longmynd," or "Bottom Rocks," or Lower Cambrian of Sedgwick.

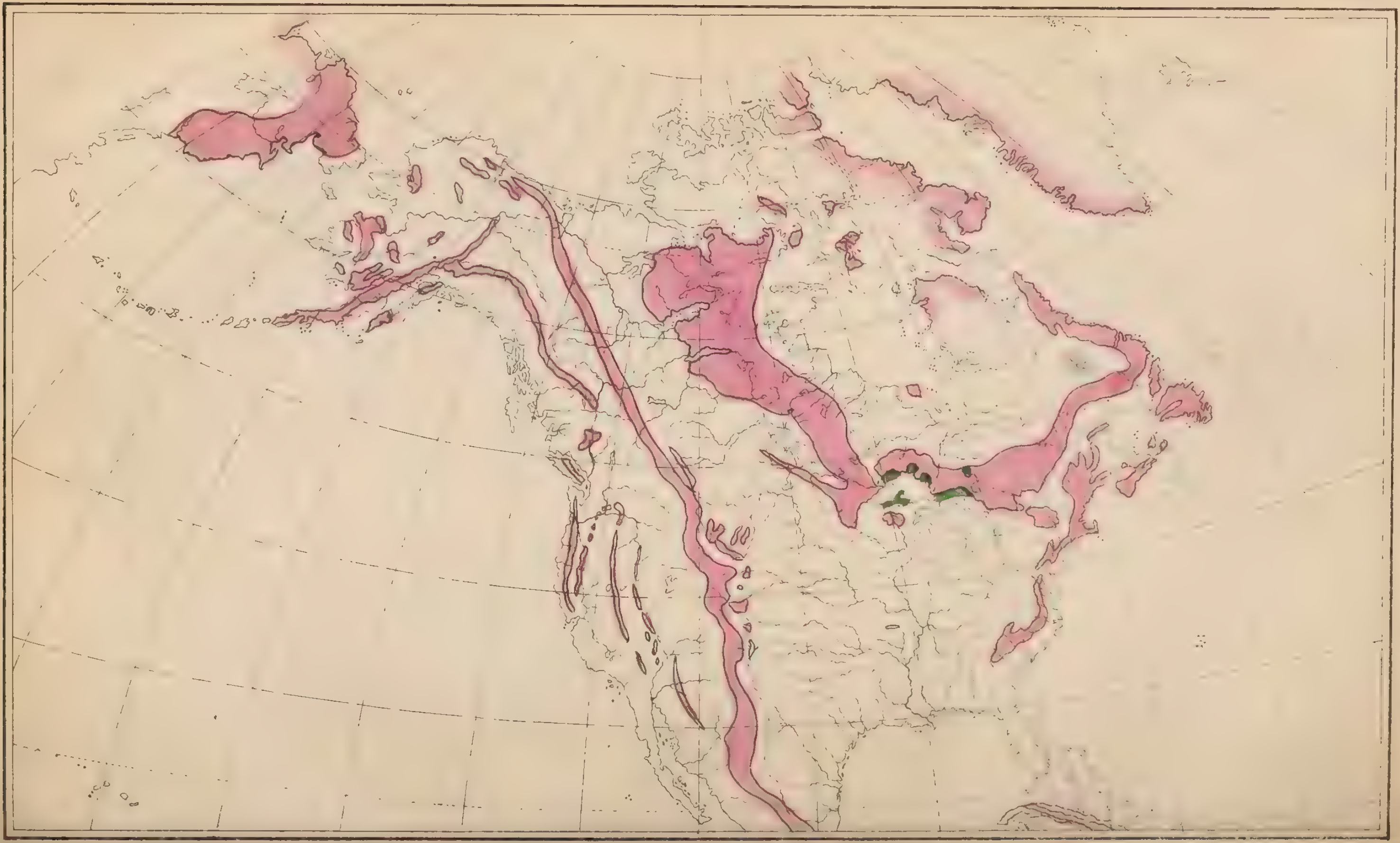
The schists on the borders of Lake Superior are of a bluish colour, and enclose beds of chert, with bands of limestone, the fissures of which are often filled with anthracite. They are often covered with a considerable thickness of trap, upon which are superimposed extensive layers of white and red sandstone, passing into a state of conglomerate, and inclosing pebbles of quartz and jasper. Beds of red argillaceous limestone are found interposed with these sandstones, which are often cut through and overlaid by a second sheet of diorite, exhibiting a columnar structure.

The corresponding rocks on the northern shore of Lake Huron have a more vitreous aspect, and conglomerates are more abundant than at Lake Superior. Great masses of intercalated diorite occur; and besides these, and of subsequent date to the inter-stratified diorites, there are two sets of dykes of the same mineral, and a third of granite, of a period intermediate between the last two.

The Huronian formation has been traced over a distance of 450 miles around the Lakes Huron and Superior, and throughout its extent metalliferous veins occur (of later origin than the volcanic eruptions), which have been as yet little worked, but which, from the proximity of the coal-fields of the neighbouring State of Michigan, must become, at some future period, a source of great riches to Canada. The well-known Bruce" and "Wallace" mines are in this formation. Metalliferous veins also occur in the Laurentian rocks.

In the accompanying map of the remnants of the primeval lands in North America, the regions coloured pink are the remains of the first dry land—the old gneissic territory or Laurentian formation of the American geologists. The spaces coloured green are fragments of the primeval sediments on its shores—the equivalents of our "Longmynd" or "Bottom-rocks"—the "Huronian formation" of Logan.

In our progress we shall add sedimentary formation after formation, until in the end will be produced a perfect map of the present geological conditions of such part or parts of the globe as the acquired knowledge of the day will permit us satisfactorily to attempt; and by this simple



but useful method we hope to teach some really practical ideas of geological phenomena.

Impracticable in the present state of knowledge, it would take years to construct such an entire map of the first dry lands, and we have, therefore, selected a portion containing the typical district, and which is certainly correct in its great features, though still wanting in some details; and in the primitive lands there pourtrayed, the long ridge extending along the western margin of the whole American continent, from the northernmost point of Russian America through the Isthmus of Panama to Cape Horn, the lunulate mass on the north side of the lakes encircling Hudson Bay, with the outlying islands and patches, appear at a glance as the framework upon which the existing territory has been elaborated and expanded in the great geological ages which have passed away, and in these remnants the primitive lands are probably very nearly represented, for, as the rock-masses were elevated, it would naturally follow that the more newly-raised and outer or marginal portions would be degraded by the action of the waves, and form the source of the materials of the subsequent deposits during successive geological periods.

(*To be continued.*)

CONTRIBUTIONS TO THE GEOLOGY OF GLOUCESTERSHIRE.

THE LIAS.

By the Rev. P. B. Brodie, M.A., F.G.S., &c., &c.

(*Continued from page* 233.)

The beds immediately below the Marlstone, which consist of laminated shales and clays often micaceous and sandy, were well exposed at the latter place during the formation of the reservoirs, and at Robinswood Hill, near Gloucester, and at Chipping Campden, on the north-eastern extremity of the county, a locality which deserves a special visit. In this part of the series, at the base of the Marlstone, a good deal of ironstone prevails, which, it is said, was in ancient times worked near Gloucester; it is of some thickness and of excellent quality at Campden. These beds are no where destitute of fossils, among which, at the last-named place, we may especially notice the fine *Ophioderma Gareyi* (one of the brittle-stars,* some species of which are so frequent in our present seas) and a new species of Pentacrinites (*P. robustus*, Wright). Here, too, at the base of the Marlstone, Mr. Gavey found two previously undescribed forms of star-fish, the *Uraster Gaveyi* and the *Tropidaster pectinatus*, both of which were figured and described by the late lamented Professor Edward Forbes, in the 3rd Decade of the Geological Survey. With them he obtained an entire and beautiful large *Cidaris Edwardsii* (Wright), with the attached spines, a rarity in this condition in any formation, and especially in the Lias, where Echinoderms are very scarce; although we have met with specimens of some small species, with the spines attached, in the upper, middle, and lower Lias.

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* Some of the recent Ophiuridæ have a singular habit of shaking off their tender arms when touched, as if in defiance of their captor, and owing to this, it is almost impossible to obtain specimens in perfection.—P. B. B.

These fossil star-fish are often obtained grouped together, as living ones are now, with their short spines adhering to the rays. Indeed, they seem to have been more than usually abundant at this spot—at least, such is the case with the *Tropidaster pectinatus*. Two or three species of small Crustacea, chiefly belonging to the genus Astacus, were also procured there in the argillaceous nodules, irregularly distributed throughout the clay. The most interesting we have seen is one in our possession, nearly allied to the recent genus Æga, belonging to the order Isopoda, and which, like others of this group, was probably parasitic upon fish. There were also a great number and variety of marine shells in a remarkably good state of preservation, and these were equally abundant at Hewlett's Hill, some of them retaining the actual shell. Although the railway at Campden has been long since finished, and the excavations for the reservoirs at Hewlett completed, the spoil-banks are well worth a careful search, and many pretty specimens may still be obtained. This portion of the Lias is particularly rich in fossils wherever it occurs; only, from its position in Gloucestershire, it is seldom exposed, and therefore cannot be so often searched as the Marlstone and the lower Lias. Similar beds were laid open in Northamptonshire during the construction of the famous Kilsby tunnel; and the organic remains there detected were nearly identical, and equally abundant. Among the most characteristic shells at all these localities, the following may be mentioned—*Pholadomya Murchisoniæ, Cardium truncatum, Plicatula spinosa, Modiola scalprum, Arca Buckmani and A. pulchra, Pecten æquivalvis, Perna* (*Crenatula*) *ventricosa, Leda rostralis, Hippopodium n.s., Nucula*, showing cast of the intestinal canal; *Trochus imbricatus, Ammonites Henleyi, A. planicostatus*, and a small grooved Belemnite. Many of these are grouped together in clusters, especially *Cardium* *truncatum*, whole blocks being nearly entirely composed of them ; and several beds of oysters were also obtained *in situ* at different depths. It is to be observed further, that the bivalves preponderate over the gasteropodous univalves in the Lias generally, and in this particular zone are several species which are limited to it. The Cephalopoda (Ammonites, Belemnites, and Nautilus) are not in this division represented by so many species as in others; although individuals are numerous, and indicate a considerable depth of water. Remains of Saurians are scarce, only a few bones and detached vertebræ of Plesiosauri having been met with; presenting thus a wide contrast with the abundance of those marine monsters in the lower part of this formation.

In our next article, when describing the underlying beds, which, in fact, compose the main mass of the Lias in Gloucestershire, we hope to dwell somewhat longer on the habits and structure of the remarkable marine reptiles which played so prominent a part in the zoological history of the earlier stages of the deposit. Indeed, there is only one other geological period during which such creatures swarmed in equal profusion, and in such numbers that they must have been the tyrants of the deep, so that the eras of the Lias and Wealden have been not inaptly termed the "age of reptiles." And, although these remains are few and far between in the upper and middle part of the series in this county, in other places they are much more frequent, as in the upper Lias at Ilminster, in Somersetshire, and at Whitby, in Yorkshire. Most people are probably aware of the general form and appearance of these saurians: a fine collection of them may be seen at the British Museum, and in various local collections, both public and private, so that ample facilities are not wanting for making acquaintance with these extinct animals,* even to those who have little or no knowledge of Geology.

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* The gardens of the Crystal Palace are enriched with noble models of these creatures.—Ed. Geologist.

NOTES OF A GEOLOGIST IN IRELAND DURING AUGUST AND SEPTEMBER, 1857.

By the Rev. W. S. Symonds, F.G.S.,

Rector of Pendock, President of the Malvern Natural History Field Club.

As the summer approaches, many of the readers of the Geologist will be preparing for their vacation-rambles; and should any think of visiting our Sister Isle—"Old Erin"—the following notes may be of service.

We started on a bright August morning of last year for the meeting of the British Association for the Advancement of Science, held in Dublin, and with the intention of travelling over as much country, breaking as many stones, gathering as many plants, and catching as many salmon as time and circumstances would permit. We were fortunate in our combination of naturalist and sportsman, but as these notes are intended solely for the naturalist, we leave our "salmon struggles" unrecorded—at least in the pages of the Geologist.

We travelled by Conway and Bangor to Holyhead, and as it was blowing a gale of wind when we arrived, we determined to wait until the sea was calmer, and, in the meanwhile, to visit the Cambrian rocks of Anglesea.

We never saw a more instructive example of contortion and twisting of rocks than is displayed at the South Stack Lighthouse, of which a good sketch is given in Sir R. Murchison's "Siluria." It is indeed a rugged coast; and the terrible Bay of Caernarvon to the south has been the locale of more shipwrecks than any other in the British Isles. We visited the grand quarries of quartzite, worked on a gigantic scale for the great breakwater. Here, as the geologist approaches the quarry from Holyhead, is a greenstone-dyke traversing the quartzite with a singular vein of pink decomposing felspathic rock. We were astonished at the magnitude of the works for the breakwater—eight, and, we believe, ten tons of gunpowder have been used in the quarries for a single explosion; and at one blast more than 100,000 tons of quartzite have been hurled downwards from the mountain-side, while upwards of six millions of tons of the rock have been buried beneath the waves that wash the shores of Holyhead. Mr. Robert Mallet read a paper afterwards at Dublin, on earth-waves caused by earthquakes;

and he had noted the effect of the explosion of eight tons of gunpowder in these quarries. The shock was so great as to be felt at the distance of two miles, and even threw crockery off the shelves of houses situated at that distance. In connection with this subject, Mr. Mallet mentioned that at Rio Gambia, during an earthquake, where the shock was perpendicular and not lateral, people were shot upwards more than two feet.

The scenery of Dublin Bay is bold and beautiful. It is backed by the Sugar Loaf and Lugnaquilla Hills; and, seen for the first time, under a bright sunshine, few persons would forget such a view. The Geological Section, at the Dublin meeting, was below its usual mark, owing probably to the absence of the most renowned of our English geologists—Lyell, the philosopher of his science, was travelling in Italy or Switzerland; Murchison was in Germany; and the veteran Sedgwick *hors de combat* with the gout; nevertheless there were some excellent papers by Professors Hennessey, Jukes, Haughton, and Harkness, Dr. Kinahan, Mr. Du Noyer, and many others; also an admirable paper on India, by Professor Oldham. The Museum of Irish Industry is a credit to Dublin, and to the gentlemen connected with that institution. It is a most instructive collection of the manufactures, the raw materials, the geology, and the mineralogy of Ireland. The stranger-geologist and naturalist wants to see Irish fossils and minerals; and here, thanks to the labours of the Geological Surveyors, he can do so without being, in any way, incommoded by boots, harps, South Sea canoes, Chinese slippers, and cobwebs. We would acknowledge the ready kindness and information we received from Professor Jukes, Mr. Du Noyer, and Mr. John Kelly, a working geologist on the staff of Dr. Griffiths when geology was more tedious and difficult than in these days of accumulated knowledge, maps, and sections. Mr. Du Noyer was good enough to point out to us one of those ancient marine worms, from the Cambrian deposits of Ireland, which was actually fossilized in its burrow! This old relic of life from the oldest known sedimentary rocks, is named by its discoverer, Dr. Kinahan, *Histioderma Hibernicum*. These "trumpet-shaped membranous tubes of a tentaculated worm" may be found both at Bray and Howth. There is also a fine series of that early zoophyte (or bryozoon, according to some), the *Oldhamia*, of which two species have been determined. Among the fossils from the Upper Silurian rocks of Dingle Promontory, the most western land of Europe, we recognized an old friend, the *Pentamerus Knightii*, of the Aymestry division of the Upper Ludlow series.

The visitor to the Museum in St. Stephen's Green should especially inquire for the case containing the fossils and plants of the yellow and red sandstones, which lie beneath the lower carboniferous limestone, and are extensively quarried in many parts of Ireland. Here we saw, for the first time, that apparently freshwater mussel of the lower carboniferous epoch, the *Anodon ? Jukesii ;* also the fossil plant named *Knorria*, and that beautiful fossil fern, *Cyclopteris Hibernica*, which has lately been found near Waterford with its fructification preserved. This fossil fern has its fructification developed somewhat after the fashion of the recent and well-known *Osmunda regalis*, or flowering fern, so abundant in the neighbourhood of Killarney.

My friend, Dr. Melville, writing me a description of this discovery, says that, "in the fertile fronds of the *C. Hibernica*, the pinnules of the primary pinnæ are divided into capillary segments, subclavate at their extremities ; but the intermediate pair of pinnules, the peculiar characteristic of the fern, are uncut, and the terminal pinnules of the primary and secondary rachides do not exhibit the capillary segmentation."

A great deal of valuable information may also be gained by examining the hand-specimens of rocks and fossils in this collection before starting for the hills and quarries, as the mineralogical character of most of the Irish strata differs very considerably from our English types, whether those strata be Silurian, Old Red, or Carboniferous.

Of course, no one, if he could avoid it, would leave Dublin without visiting the other public places of interest, especially the Irish Academy, with its gold and jewelled ornaments of a by-gone race. We were amazed at those gems, "so rich and rare," evidently the work of artists of exquisite skill and taste. There are torques, or twisted collars of pure gold, as old, probably, as the period of Torquatus, who slew a Gaul in the year of Rome, 393, and afterwards wore the "torc" he took from the body. There are jewelled cups, and vases, and gold ring-money of the ancient Celts ; and there are bells of the time of St. Patrick, with gorgets, bracelets, and brooches. It is recorded that at the Dublin Exhibition of 1853, more than 60,000 objects of antiquity were collected together. There is, also, a model of what might be almost termed a fossil house, discovered beneath Drumkelin bog, in the county of Donegal, with its pathway of flags, and the roots of the trees that sheltered it, and the marks of the woodman's tool on its timbers. Yet all around, above, and within this dwelling was a solid mass of bog ; for it was sixteen feet below the surface. There are some magnificent specimens of the majestic, but extinct, Irish Elk, *Megaceros Hibernicus*, to be seen at the College. The antlers of some skeletons of this gigantic deer are more than nine feet in expanse ; and these creatures stood, when living, ten feet four inches in height, and their length, in proportion, was ten feet ten inches ; while that of the American moose-deer is but six feet.

The Botanic Gardens at Glasnevin are well worth a visit, and we shall long remember the lovely faces we beheld on the occasion of the fête given to the members of the British Association. There are some matchless specimens of the Killarney fern, *Trichomanes radicans*, the property of Mr. Moore, the Curator, which are valued at a fabulous price. The traveller would do well to ask to be allowed to see these specimens, as it is very improbable that he will meet with any at Killarney, the *Trichomanes* having been nearly eradicated by over-selfish collectors.

The geology of the Dublin district is of great interest, and we recommend excursions to Howth, Ireland's Eye, and Lambay Island ; but let every geologist first provide himself with a reduced copy of Sir R. Griffith's Geological Map of Ireland, which may be purchased for a few shillings at Forster's, 2 Crow Street, Dublin.

Mr. Du Noyer directed our attention to a remarkable junction of slate and granite at Killiney Hill. Veins of granite and eurite here traverse the granite and slates ; but the interstratification of the slates with the granite is merely in appearance, for the slates are caught up in the granite, and are not really interstratified.

On the Irish Cambrian deposits we have a few words to say. We visited Bray Head, with its "Oldhamia schists," in company with several good geologists and pleasant companions, and were conducted by that veteran geologist, Mr. John Kelly, to the best localities for obtaining good specimens of those ancient zoophytes which lie there in thousands, bedded in the rocks, which are mostly covered by the waves at high tide. A happier party could hardly be met with than the half-dozen hammerers who sat, in the August sunshine, on the sea-shore, and knocked out the Oldhamias from the rocks, or watched the seagulls fishing in the bay.

The Cambrian deposits were long believed to be unfossiliferous, and to represent a period of this planet's history before the introduction of life upon it. Yet we have now contradicting evidence in the presence of zoophytes and sea-worms in the "Oldhamia beds" of a trilobite, annelids, and fucoids, with rain-marks, on the old beach in the equivalent rocks of the Longmynds. Some of us thought that it might be a mis-reading of the geologic records to imagine the creative fiat terminating for ages in sea-worms or Lingulas, or that no other animals lived in the Cambrian epoch because geologists have not yet discovered their remains. Geologists know but little, as yet, of Cambrian deposits and their organisms. Every day the depths of the present seas are yielding new treasures to the dredger; and genera of animals supposed to be extinct appear to overthrow theories and presumptions. We believe it would be wiser to wait a while, ere we talk of "eternal oceans," "wastes of uninhabited shore," "tenantless Cambrian lands," or Cambrian seas inhabited solely by zoophytes, fucoids, sea-worms, and a few trilobites.

As far as the physical geology went, we thought the Bray beds very unsatisfactory, and were obliged to rest content with the assurance that they are seen to underlie unconformably beds which may be the equivalents of our "Lingula-flags," to the west of Bray.

It is impossible to say too much of the rich glow and blending of colour we beheld in the hills of Wicklow during the walk of that afternoon. The hills were purple and gold with the beautiful bell-flowered heath and the yellow blossoms of the gorse. We returned to Dublin by a late train, and, before parting, agreed to make that a "red-letter day" which we passed among the "Oldhamia-schists" and flower-spangled hills of Wicklow. Surely such days should be marked, they are golden hours in a man's life, for which we are to be grateful. He must have a hard heart who can return home, after such a day, cherishing envy or uncharitableness, or who can pass hours among the noble works of creation by the bold sea, the rock of ancient days, under the clear sky and among bright flowers, without a feeling of gratitude towards Him whose wondrous works they are, and who has given us the capability so deeply to enjoy them. As for only philosophers enjoying these things, it is the appreciation of them that elevates the man into the philosopher—the lover of wisdom.

(*To be continued.*)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Formation of Prairies and their relation to Peat-bogs.

(*Continued from page* 248.)

The distinguished botanist, M. Alphonse De Candolle, has remarked, that these ideas of M. Lesquéreux are undoubtedly true as regards a great number of prairies, but they cannot be applied, he thinks, to every country, nor can he admit that they are applicable to all the prairies of North America. M. Desor, who has also visited the United States, and who was present at the reading of M. Lesquéreux's paper, says he cannot attribute to the above causes the formation of what are termed *prairies roulantes*, or undulating prairies, which are very frequent in North America. We might also object that in hot countries—for instance, in Louisiana, on the banks of the river Amazon, of the Oronocco, of the Ganges, &c.—we have examples of ligneous vegetation in the shape of trees belonging to the families of the *Anonaceæ*, *Rhizophoraceæ*, and even *Papilionaceæ* and *Aviccnneæ*, which transform the marshy banks of these rivers into jungles—often into magnificent forests.

New observations on Silica—Its radical Silicium compared with Carbon and Boron—Composition of Carbonic, Boric, and Silicic Acids—The Archegosaurus—Sand-banks of the Pacific Ocean—Effects of Earthquakes upon Animals.

Silicic acid is found in nature in the form of sand, sandstone, silica, flint, quartz, amethyst, agate, opal, jaspar, silicified wood, &c. Combining with the different oxides, it forms salts called Silicates. Thus the emerald is a silicate of alumina and glucina; garnet, a silicate of alumina and iron; calamine, a silicate of zinc; clay, a silicate of alumina; talc, a silicate of magnesia, &c.

Silicic acid is, therefore, one of the most abundant of mineral substances, and, at the same time, one of the most universally diffused. Kœne says it is "the most abundant of all bodies," and that "it forms two-thirds of the earth's crust;" and this figure is far from exaggerated. The true nature of silicic acid, however, only began to be investigated about the year 1807, and its composition was not rendered evident until a few years later, when Berzelius extracted from it silicium, a simple element, which, on combining with a certain quantity of oxygen, produces the white powder known as silicic acid.

Up to the present time, the nature and properties of both silicium and its acid have been very incompletely known. We are told in books that silicic acid is composed of one atom of silicium and three atoms of oxygen; that silicium is a brown powder, and that its atomic weight is

22. And with this knowledge, as a basis, have been analyzed and classed the innumerable varieties of silicates found in nature. We dare not mention here even the approximate number of these silicates considered as known. It will be almost needless, from what follows, to add that long ago the study of this group of minerals became incredibly difficult, their classification in many cases extremely doubtful, and the chemical formula assigned to a great number perfectly absurd. Thanks to the efforts of some very eminent men, this state of things seems to be approaching its end, and a more exact knowledge of the composition of silex, and of the nature of its radical silicium—attained only within the last few months—seems likely to throw a considerable light and quite a novel aspect on the group of silicates.

The great physical and chemical resemblance which silicic acid bears to stannic acid (oxide of tin, $Sn\,O^2$) and to titanic acid (oxide of titanium, $Ti\,O^2$) made us suppose, some time ago, that the former, instead of containing three atoms of oxygen ($Si\,O^3$) only contained two ($Si\,O^2$). This idea haunted us the more, when, reflecting upon the uncertainty which has hitherto prevailed as to the atomic weight[*] of silicium, and still more on perusing a recent memoir by M. Gaudin, in which, by an ingenious theory of his own, the author endeavours to explain the crystalline forms of bodies by a mathematical groupment of their atoms. M. Gaudin told us the other day that his theory of crystals had occupied, during thirty years, most of the leisure moments of his active and laborious life; and that it was impossible to explain, by its aid, the crystalline form of quartz, unless he supposed this substance to be $Si\,O^2$, and not $Si\,O^3$, as was, and is, generally supposed.

Wöhler and H. Saint Claire Deville observed lately that silicium could be dissolved in melted aluminium, which, on cooling, throws out the former in beautiful crystals. We must remark here that a most striking analogy exists between the three elements—carbon, silicium, and boron. This analogy has now become more apparent than ever, and is extremely interesting in a mineralogical point of view.

Carbon is known to exist in three distinct states—namely, 1, as diamond; 2, as graphite; and 3, as a black non-crystalline powder (coal, charcoal, lamp-black, &c.). Carbon combines with oxygen, and forms carbonic acid ($C\,O^2$) and carbonic oxide ($C\,O$.)

Silicium has just been obtained by Wöhler and Ste-Claire Deville—1, in transparent crystals as hard as the diamond, to which they bear a certain resemblance; 2, in metallic crystals, imitating graphite; and 3, as a black non-crystalline powder resembling coal. Silicium combines with oxygen, and forms silicic acid, which we shall show presently is $Si\,O^2$, and silicic oxide, discovered a few months ago by Wöhler and Buff, and which, in all probability, is $Si\,O$.[†]

Boron has just been obtained by Deville—1, in form of transparent crystals resembling the diamond, though generally of a reddish tint, and in this state it is the *hardest of all substances* yet known,* and scratches the diamond with ease; 2, in metallic crystals, resembling graphite; and 3, as a black amorphous powder. Boron combining with oxygen forms boric acid (a white crystalline powder much resembling silicic acid by its chemical properties), discovered in 1872 by Homberg, found in 1776 by Hœffer and Mascagni in the waters of the Lakes of Castel Nuovo, Monte-Cerboli, &c., in Tuscany, and hitherto regarded as $Bo\ O^3$; that is, formed with one atom of boron combined with three atoms of oxygen. But as boron is isomorphous† with tin, and as stannic acid, silicic acid, carbonic acid, and titanic acid contain only two atoms of oxygen, it is probable that boric acid will sooner or later turn out to be $Bo\ O^2$. No other oxide of boron has yet been discovered.

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[*] The proportion in which one body combines with others is called in chemistry its "atomic weight" or "equivalent."—T. L. P.

[†] This new oxide of silicium is a white powder obtained from chloride of silicium; when it comes in contact with water, hydrogen gas is evolved, and silicic acid formed.—T. L. P.

Many chemists have endeavoured to ascertain the atomic weight of silicium, which is generally thought to be 22. M. Marignac, the well-known and indefatigable chemist of Geneva, has just found that this number must be changed to 14; and that silicic acid is, consequently, composed of one atom of silicium and two of oxygen ($Si\ O^2$). When M. Dumas presented this result to the Academy of Science at Paris, a few days ago, it created, as may well be imagined, considerable sensation. The illustrious Berzelius himself had once remarked the probability of this formula, and Leopold Gmelin always looked upon quartz as composed of one of silicium and two of oxygen. Mr. Miller in his "Mineralogy" advocates the same opinion, which was even suspected to be the exact one thirty years ago by Dumas; and, finally, M. Gaudin, M. Marignac, and ourselves only waited for sufficient experimental proof to adopt it once for all. Indeed, we were on the point of again consulting our balance to investigate this question anew, when the results obtained by M. Marignac were laid before us.‡

M. Hermann von Meyer, the well-known palæontologist, whose name has already appeared in one of our former papers, has announced to the Academy of Sciences of Paris, that he is about to send to that Society a work which he describes in these words: "My work treats of the Archegosaurus, the most marvellous animal that ever existed. The creature belongs to the family of the Labyrinthodonts, which became extinct before the end of the Triassic epoch. I have been fortunate enough to determine the entire organization of the Archegosaurus§ at each period of its life. It was in studying this animal that I first discovered the persistence of the embryonic condition of the vertebral column in certain fossil reptiles, analogous to that observed in many fish, both living and fossil. This discovery appears to me as important in a geological as in a physiological point of view."

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* Until now the diamond has been considered the hardest substance in nature. —T. L. P.

† "Taking the same crystalline form."—T. L. P.

‡ Marignac's Paper, which is extremely interesting, has been published in the *Comptes Rendus* of the Paris Academy of Sciences for the 3rd of May, 1858. Its purely chemical nature prevents our laying the details of it before our readers.—T. L. P.

§ For some late observations on the Archegosaurus by Professor Owen, and an examination of some of M. von Meyer's views of its structure, see Annals Nat. Hist., 3rd Ser., vol. I., p. 320.—Ed. Geol.

M. Wenceslides writes, from Hermannstadt (Transylvania), on the sand-banks of the Pacific Ocean. He thinks that many of them, especially those of the Indian Archipelago, ought to be explored. "It might be done," he says, "without difficulty, and would be useful to the arts, inasmuch as those sand-banks would, no doubt, be found to contain the same precious metallic ores that are now observed in the alluvial formations of the neighbouring coasts, of which the sand-banks in question appear to be a prolongation." In a letter upon some earthquakes at the Cape of Good Hope, to which we shall refer again shortly, M. de Castelnan, French Consul, says that during these phenomena, "the lower animals appeared as frightened as the men." This came to M. Boussingault's ears, who feels inclined, from his own observations, to uphold a contrary opinion. This distinguished naturalist and traveller tells us, that during the violent earthquakes he witnessed in South America, he observed that certain animals showed, with regard to this terrible phenomenon, the utmost indifference. As M. Boussingault was at that time living in a house constructed entirely of bamboo-stems and the leaves of palm-trees, he was not threatened with being crushed to death by the falling-in of his establishment, had such an event taken place. He was, therefore, perfectly at liberty to observe the most awful phenomena of this kind at his ease. The following lines, written during his stay in South America, are taken from one of his MS. note-books:—"At six o'clock in the evening I was sitting in my chamber, when I suddenly felt a violent shock; it appeared to me that some one was trying to force open the door of my habitation, but, as the shaking movement continued, I went out, and found my servants on their knees praying in the utmost consternation. The earth oscillated horizontally without ceasing, and in a north-west and south-east direction. This lasted for five or six minutes. . . . During the phenomena two goats that were in my field remained quietly reposing on the ground. Two mules which were standing at a little distance continued to graze, as if nothing remarkable were taking place, and as if the ground had been perfectly still. My cat, profiting by the disorder into which our kitchen was thrown, actually committed a theft by running off with a piece of meat. . . .When the earth had ceased moving, we heard sixteen detonations, at intervals of thirty seconds. The noise of each was instantaneous, or without rumbling, and resembled the report of distant cannon in a south-easterly direction."

GEOLOGICAL DESIDERATA.

POINTS OF GREAT INTEREST IN THE STUDY OF THE LONGMYND, SILURIAN, CARBONIFEROUS, PERMIAN, OOLITE, AND CRETACEOUS ROCKS.

The Editor presents the following letter from Mr. J. W. Salter, Palæontologist to the Government Survey, to the readers of the GEOLOGIST, with an earnest request that the effort he is making, by means of this department of this Magazine, to promote the real advance of science, may be fully seconded by all to whom these most desirable points of investigation may become known. The names of Mr. Prestwich and Mr. Salter are guarantees for the value of the work required to be done.

To the Editor of the GEOLOGIST.

DEAR SIR,—Your correspondent, Mr. Prestwich, has opened the inquiries which, above all others, appear to me to be suitable to the pages of the GEOLOGIST. I have long intended to write to you on the subject, but am very glad to see our able friend commence it.

What we want, in the present state of geology, is *abundance of good facts*, and these can only be collected by the industry of local observers, who will communicate these results in a tangible form, available for the workers on particular subjects. If these last will, as Mr. Prestwich has done, point out the work, and you, Sir, will undertake to condense and tabulate for them the facts collected, the more critical and obscure points which still remain as *opprobria* in our British geology may be wonderfully cleared up.

The labour and expense of time which private correspondence (often, too, very unsatisfactory) entails upon a student will be thus saved. And then, again, there is no pleasure so great as in working for a definite object, with the certainty that your results, however small, will aid in attaining it. Many a holiday may be most profitably occupied (which would otherwise be lost) by confining the attention to one bed, or a set of beds, instead of hammering away under a vague impression that something is to be done, though you know not exactly what.

The points to be worked at are numerous enough, and will occur to many geologists.

1. Why should we not have a really fine series of fossils from the Longmynd rocks, near Church Stretton?

2. West of the Stiper Stones, Shrophire, a strip of country, a mile wide, should be thoroughly explored for fossils, as there are here beds of passage between the Lingula-flags and the Llandeilo rocks, and of the greatest geological interest. Shells and Trilobites are abundant.

3. St. David's Head, in Pembrokeshire, too, wants a good hammering. The conglomerate-beds north of the Towy will give a whole summer's

work to any gentleman who would devote his leisure to them. And the Devil's Bridge, Aberystwith, should be ransacked for fossils; they are to be found there, yet the age of these rocks is very imperfectly known.

4. The *Cornstones* of the Old Red have some good observers among them; but there is a great deal yet to be done in these, while there cannot be too many hammerers upon the transition-beds between the Old Red and Upper Silurian.

5. The Carboniferous rocks have been well studied, and nothing seems wanting but to follow up, for other districts, the patient work that Dr. Bevan is doing in South Wales, and ascertain, for all the coal-fields, the distribution of the plants in the various parts of the series. Now that the Survey-maps are so far advanced, this is comparatively easy, since no one can be in doubt about the particular beds he is at work upon.

6. Mr. G. Roberts' communication, p. 253 of your last number, opens a subject well worth patient investigation—the vegetable contents of our own Permian strata, especially the lower beds. While these beds on the Continent are full of peculiar species, in good preservation, we, in England, hardly know a dozen specimens of any value from them.

7. Again, where is the representative of the Muschelkalk, or any of its fossils, in Britain?

8. The contents of the Inferior Oolite Sands are yet only partially known.

9. The transition-beds between the Wealden and the Lower Green Sand, and especially the true relations of that remarkable bed the Chloritic Marl (Craie Chloriteé) of the south-east of England, whether with the Chalk Marl above or the Green Sand below, are subjects of great interest. These ought to undergo a rigid examination.

I have only sketched a few of the many points which might be attempted during this present summer by field-clubs, or by private geologists working for their own amusement. Perhaps if I were to specify two of the more interesting points which deserve notice, I should say—

First. The contents of the Permian strata in the central counties where the magnesian limestone is absent. Their boundaries are laid down in our new geological maps.

Second. A full list of fossils from the beds which connect the Carboniferous with the Devonian system. On this subject I hope to send you a further communication, and can only say, that careful collections made on the two sides of the great Culm-basin of Devonshire, viz., at Barnstaple, North Devon, and at Petherwyn, in Cornwall, would produce good results. We know something of the contents of these from the work of Professor Phillips, and the still earlier researches of Sedgwick and Murchison; but accurate details are wanted from both localities. The old lime-quarries at Petherwyn, and more especially the fossiliferous slates associated with them, will require long and continued search before a series of fossils in sufficiently good preservation could be obtained to make accurate lists, but they are very abundant.

Mr. S. R. Pattison has published some important facts regarding those localities, in the "Transactions of the Geological Society of Cornwall," Vol. I., and it only needs to follow out the inquiries begun by him to enable us to understand very clearly the age of the Petherwyn slates, and their relation to the base of the Culm-series, which overlies them. Near Barnstaple, the most instructive sections are from Pilton to Sloly, at Braunton, and at Baggy Point. But these have been comparatively well examined; the point that most wants investigation is the south coast of the Barnstaple river, along the promenade, and thence round to the angle opposite Heanton Court.

These fossils are probably the same as on the opposite bank from Stroud to Heanton Court, but a good series of each should be compared and named from Phillips' Palæozoic fossils. Then the shores of Fremington Pill offer a perfect section of the higher beds from opposite the Weir to the cutting of the Bideford Railway. The fossils will be found to be different to those of Heanton, in some respects, and mostly Carboniferous-limestone species. (Phillips' Geol. Yorkshire, and M'Coy's Synopsis of the Carb. Foss. of Ireland, will give the names.)

It will be necessary to go when the tide is half out; but the abundance of fossils in the nodules, to say nothing of the beautiful scenery of the river-banks, will well repay a little trouble, and the beds are all easily accessible. For more adventurous hammerers the south and north cliffs of Baggy Point will afford much interesting work; but this I will point out more fully in a future number. The point to which these researches lead is the true boundary between the Carboniferous and Devonian rocks, not yet ascertained for Britain.

For tourists in the West of Ireland, the fossiliferous beds along the south-east shore of Glengariff Bay will show the transition from Old Red* Sandstone into Carboniferous Slate, and they are highly fossiliferous. Dunworly Bay and the Seven Heads, County Cork, is a fine section for boat-excursions, and there are others equally interesting. There are abundance of new species to be obtained, but the object should be to ascertain, by well-collected specimens, where the Carboniferous fauna *ends* downwards. To place (as many geologists are now inclined hastily to do) the whole of the upper or conglomerate portion of the Old Red Sandstone in the Carboniferous system, is not to be done without a more rigid inquiry into the organic remains where these are to be had. But, on the other hand, careful and numerous collections may prove this to be necessary.

I am, dear Sir, yours truly,

J. W. Salter.

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* See Journal Dublin Geol. Soc., Vol. VII., Pt. 2, p. 63.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Proceedings of the Geological Society of London.—May 26, 1858.—1. "On the Pleistocene Sea-bed of the Sussex Coast, being the Western Extension of the Raised Sea-beach of Brighton." By J. Prestwich, Esq., F R.S., F.G.S.

The author first observed that the well-known raised beach at Brighton, described by Dr. Mantell, has been since extended by Sir R. Murchison to Hove, and by Mr. Dixon to Lancing and Broadwater near Worthing; and that Mr. Godwin-Austen has described some marine beds, which he ascribes to the same age, on the coast between Bognor and Bracklesham. He then proceeded to state the results of his examination of the country between Brighton and Havant. Traces of this old sea-beach are, in Mr. Prestwich's opinion, to be seen on the slightly raised ground at the base of the chalk-hills east of Arundel, at a distance of three or four miles from the sea. It is much more distinct westward of Arundel, and can be followed to near Chichester. In a wood at a short distance north of the road from Arundel to Chichester, and about two miles from the former, these beach-deposits appear as a bed of sand about seven feet thick, with thin patches of shingle, and overlaid by subangular flint-gravel. On the brow of Avisford Hill the same bed of sand is seen to overlie the mottled clays; and in a sand-pit in the wood east of Slindon Common, similar pebbly sand, at least 16 feet thick, is seen to be overlaid by partially rounded flint-shingle, about three feet thick, and both to be covered by ferruginous sandy clay full of large angular flints, which occupies also a furrow excavated through the shingle into the sand. A mass of brick-earth, 10 feet by 8, forms a core to the ferruginous clay in the furrow. It is to be remarked that the sand-bed is here about 100 feet above the sea-level; and also that it is intersected by a deep dell. The angular flint gravel, underlaid by the sand, stretches across Slindon Common, occurs at Broxgrove Common, and at intervals towards Goodwood. At Waterbeach, adjoining Goodwood, a sand-pit shows, in descending order, 1. ferruginous clay, full of angular flints, two to six feet; 2. chalk-rubble, about nine feet thick, containing small angular flints, and with a furrowed surface; 3. fine ash-coloured sand, slightly micaceous, with thin seams of concretionary sandstone, some few boulders of chalk, and friable shells.

The shingle-bed, seen at Avisford, is here replaced by chalk-rubble, like that overlying the old beach at Brighton; but no shells nor bones were found. Shells of the common *Mytilus* and the edible *Cardium* are found in the sand, but they are usually very friable; and in the holes made by *Pholades* on the large lumps of hard white chalk occurring in this sand, specimens of *Purpura lapillus* occur, whilst small *Balani* are attached to the surface of these chalk-boulders. A specimen of *Echinocyamus pusillus* was also met with. This sand deposit, which the author believes to be identical with the old Brighton beach, he traces also westward of Goodwood to near Lavant and probably to Bourne Common.

2. "On the Sedimentary and other External Relations of the Palæozoic Fossils of the state of New York." By J. J. Bigsby, M.D., F.G.S.

The objects proposed in this inquiry were—to give more precision to facts as yet imperfectly ascertained, to discover new materials for the history of these earliest times, and to treat of new points of connection between the Palæozoic Basins of New York and Wales. The first part of this memoir commenced with a few observations on the agencies by which the palæozoic sediments or sea-bottoms were laid down, namely, 1st the constant and superficial, or Neptunian, and 2nd the modifying or occasional and subterranean (Plutonic); and then proceeded to describe their mineral character. In the second part, the distribution and immediate relations of palæozoic animal life in the state of New York were considered; and in the third part the recurrence or vertical range of fossils was treated of in detail. Lastly the results arrived at by the author were given as reflections presenting themselves on a survey of the ancient and vastly prolonged processes that laid down the palæozoic strata of New York. The unity of design and predetermination of the complete idea manifest in these geological phænomena,—the evidences of direct creation and of occasional migrations,—the conditions of contemporaneity,—the relations of geographic and epochal centres of life,—the laws of recurrence of animal forms, or their reappearance in new epochs, and of the disappearance of faunæ,—and lastly the points of similarity and of dissimilarity between the palæozoic rocks of Wales and New York were, in the concluding portion of the memoir, fully dwelt upon.

June 9, 1858.—1. "On Jointings, and on the Dolomites near Cork." By Professor Harkness, F.R.S., F.G.S.

The strata in the neighbourhood of Cork consist of Devonian rocks, and the lower portion of the Carboniferous series. In the former a regular system of north and south joints occur, cutting through the strata at nearly right angles to their strike. The carboniferous rocks are also intersected by joints having a similar direction; but in these latter rocks other joints occur, one system of which approaches to the horizontal, and the other is inclined sometimes towards the east, at other times towards the west. This threefold system of jointings, which make their appearance in the carboniferous rocks, is not equally prevalent in all the members of this series.

The limestones in which they occur in the greatest perfection are such as have the greatest amount of carbonate of lime, and are of the purest character.

In some siliceous limestones, which are associated with the more perfectly jointed rocks, the series of jointing is confined to such as prevail in the Devonian strata, these having only the north and south system of divisional planes. Respecting the north and south series of joints, the author is disposed to regard them as resulting from pressure, caused by the movements which have given to the strata in the south of Ireland an arrangement in the form of rolls, having an east and west strike,—a course at right angles to the direction of the principal joints.

In connexion with these north and south joints, both in the limestones of the carboniferous series and also in the underlying carboniferous slates, the author has noticed distortions of fossils, and this distortion consists of an elongation between the series of joints, the fossils being pulled as it were out towards the sides of these planes, or at right angles to the strike of the joints.

Prof. Haughton has already noticed the elongation of the fossils in the direction of the strike of cleavage, a mode of elongation at variance with that described by Prof. Phillips and the late Mr. D. Sharpe.

As this direction (of distortion), however, occurs among strata in the north of Ireland devoid of cleavage, the author is disposed to regard it as resulting rather from jointing than from cleavage, and he regards it as evidence that pressure has exerted considerable influence in producing *joints*. Concerning the other two systems of joints, which are peculiar to the purer limestone, these have a disposition to split the masses of limestone into rhomboids; and these divisional planes, the author considers, result from the same cause as the principal joints; but, owing to the pure state of the limestone, lines of division akin to *mineral cleavage* have intersected these strata, and given to them their complex series of jointings.

Dolomites also occur in the limestones of the district around Cork. They usually are met with in a dyke-like form, and in general are found conforming to the strike of the perpendicular north and south joints, or, in other words, intersecting the strata at right angles.

In some instances, however, they have an east and west course, and are found associated, in this condition, with the siliceous limestones which possess only the principal system of joints.

These dolomites, from their mode of occurrence, have had their origin subsequent to the production of the joints, and are often found thinner below than above. From the circumstances of their occurrence, the author is disposed to regard them as metamorphosed ordinary limestones, and the metamorphic action he is disposed to attribute to sea-water, which, containing sulphate of magnesia, has found access, by means of the joints, into the limestone masses; and this at an elevated temperature, combined with pressure, has produced these changes, by the double decomposition of sulphate of magnesia and carbonate of lime, and, by this means, given rise to the production of the dolomites occurring in this neighbourhood.

2. "On an Experiment in melting and cooling some of the Rowley Rag." By W. Hawkes, Esq. Communicated by the President.

About 31 cwt. of basalt was melted in a large double reverberatory furnace, and after a slow cooling during 13 days, it presented un upper stratum of stony vesicular matter, about 1 inch thick, next a layer of black glass, from 2 to 8 inches deep on that side of the mass which was exposed to the air from the door of the furnace (elsewhere, immediately under the vesicular layer was solid stone, interspersed here and there with air-bubbles). Mr. Hawkes added some observations relating to the results of experiments which he had made to ascertain the temperature of melted cast iron, and of melted basalt.

3. "On the Iron ores of Exmore." By Warington Smyth, Esq., M.A., Sec. Geol. Soc.

The author described the occurrence of ores of iron within a district of about thirty miles in length, between Ilfracombe and the Bridgewater Flats, in slaty rocks belonging to the "greywacke" of De la Beche's "Report on Cornwall," or to the "Plymouth Group" of the Devonian System, as described by Sedgwick and Murchison. They are situated partly to the north, but chiefly to the south, of the irregular bands of limestone which pass from Combe Martin eastward by Simonsbath to Cutcombe and Treborough. The really stratified deposits of iron-ore are bands of argillaceous nodules, alternating with shales, similarly to those of the coal-measures; and these have been found in abundance on the flank of Hangman Hill near Comb Martin, and in the north forest of Exmoor; but in general, their angle of inclination is too great to allow of their being worked in competition with the analogous ores of the coal-fields.

The lodes containing iron-ore, extensively worked some centuries ago, and which have recently been explored in the Brendon Hills, and tested on the property of F. W. Knight, Esq., M.P., are so nearly conformable to the beds of slate, striking about E. 10 degs. S., with a dip of from 45 degs. to 65 degs. southward, that they might be easily taken for stratified deposits.

In several places, as at Cornham Ford, the Roman lode, and the little Woolcombe lode, hæmatite has been found at or near the surface, containing 98·4 per cent. of peroxide of iron, in masses which present the structure of sparry iron or carbonate. Most of the lodes, however, especially those of the Deer-park on Exmoor, and Raleigh's Cross, consist of brown or hydrous peroxide, generally occurring in large cavernous masses, with the interior of the cells often lined with brilliant but minute crystals of Goethite (pure hydrous peroxide), yet exhibiting the rhombohedral structure of sparry ore. Analysis shows this ore, especially from certain of the Exmoor veins, to contain 71·3 per cent. of peroxide of iron, together with a considerable per-centage of oxide of manganese.

Lastly, several of the veins prove in depth to consist of sparry ore (siderite or carbonate of iron), containing a notable per-centage of carbonate of manganese. This has especially been shown at Goosemoor, Huel Eliza, Hangley Cleave, and on Kentisbury Down. The width of these veins varies from a few inches to above 20 feet, and at the greatest depth hitherto reached, 110 feet, there is no deterioration in size. Quartz-veinstone and fragments of slate occasionally fill part of the lodes, and this fact, coupled with the interruptions of "slides" and "heaves," has led to some misplaced disappointment on the part of those who made their calculations without taking into account the capricious nature of true veins.

Hence it appears,—1st, that the vein-fissures have been formed in this district almost solely in planes conformable to those of stratification, and that, after having been filled with carbonate of iron, quartz, &c., they have been more or less disturbed.

2ndly. That the sparry ore has been converted, often to a great depth, into Goethite or pure hydrous peroxide, the consequent decrease of bulk giving rise to the cellular cavities lined with crystals.

3rdly. That some smaller portions have been converted into hæmatite, having probably passed through the intermediate stage of brown peroxide.

4thly. The pebbles of hæmatite at the base of the New Red in the adjoining district appear to be derived from these lodes, and would indicate their having been filled with ore prior to the great spread of deposits of red and brown iron-ore which took place in S.W. England and South Wales soon after the deposition of the coal-measures.

The interest attached to these pseudomorphous changes, and to the scale on which they have taken place, is heightened by comparison with the ores of Siegen, of Sommorostro near Bilboa, and those brought by Dr. Livingstone from Central Africa.

4. "On Native Copper in the Llandudno Mines, near Great Orme's Head, North Wales." By Capt. W. Vivian, of the Llandudno Mine. Communicated by J. Taylor, Esq., F.G.S.

The author described some microscopic arborescent crystallizations of native copper occurring with ruby copper in small cavities in a brown limestone, which contains yellow bisulphuret of copper. Harder sulphurous ore occurs in the bed below, and carbonates and oxides of copper in the bed above. The arborescent copper is probably the result of the decomposition of copper ores, and has been formed subsequently to the crystals of lime in the limestone, which are often tipped with an octahedron of ruby-oxide, or overlaid with spikes of the native copper.

5. "On the Slate-rocks and Trap-veins of Easdale and Oban." By Professor James Nicol, F.G S.

The author first described the mineral characters of the clay-slate of the Islands of Easdale and Seil, and noticed the iron-pyrites and the veins of calc-spar and of quartz occurring in the slate as well as gritty and calcareous strata that are detected as interstratified with the more highly cleaved beds of the slate; also some soft carboniferous beds and some hard calcareous nodules, imbedded in the slate. In one of these nodular masses, at a depth of 140 feet from the surface, a small quantity of bitumous coal was stated to have been lately found. Fucoidal or annelidal markings occasionally appear in the slates. Professor Nicol then described the original but obscure stratification of the Easdale slate, which, with care, is seen to present beds disposed in undulations, and, where most clearly seen, dip at a high angle to the west or north-west. Near Oban, and along the Sound of Kerrera, the stratification is more distinct, and the strata are very much contorted. The slaty cleavage of the district was then treated of in detail. Its average strike varies 20° from that of the beds; and the direction of strata and cleavage-planes have evidently a connection with the more ancient and deep-seated causes which have produced the most striking features in the configuration of the country; they are nearly parallel to the shores of Loch Linnhe, to the Island of Lismore, and to the great depressions occupied by Loch Etive, Loch Awe, and Loch Fyne. The trap-veins of Easdale and Oban were next described, especially a pitch-stone at Seil; and were shown to be of three periods. At least two sets of the veins appear to be of a date subsequent to the Jurassic period; and the author remarked, as an instance of the very recent date of many of the great convulsions by which the present physical outline of Scotland has been produced, that the mountain-cliff, 1,200 to 1,500 feet high, forming the coast of Morne, between Ardtornish and Loch Linnhe, consists in half of the old gneiss, in half of lias-strata and recent trap, brought side by side with each other along an enormous fault, and now smoothed down into one uniform mass. In conclusion, Professor Nicol stated that he considered the Easdale slate to be of Lower Silurian age, but younger than the slates of Birnam and Dunkeld.

Specimens illustrative of the several papers were exhibited; also a series of North American fossils collected, described, and presented by Professor Jules Marcou of Zurich.

SWINEY LECTURES ON GEOLOGY, IN CONNECTION WITH THE BRITISH MUSEUM.—This annual course of twelve lectures was commenced by Dr. A. G. Melville, Professor of Natural History in the Queen's University, Ireland, at the Museum of Practical Geology, Jermyn-street, on the 14th of June, and delivered as follows:—June 14th, Subject-matter of Geology; Classes of Rocks. 15th, Composition of Rocks;

Stratification. 16th, Igneous Action; Volcanos, Earthquakes. 17th, Elevation and Plication of Rocks; Faults. 21st, Cleavage and Foliation. 22nd, Denudation; Unconformability. 23rd, Lower Silurian System of Rocks. 24th, Upper Silurian System of Rocks. 28th, Devonian System. 29th, Carboniferous System (Marine Series). 30th, Carboniferous System (Coal-measures). July 1, Permian System. The admission to these lectures is free.

General Meeting of the Woolhope, Worcestershire, Malvern, and Cotteswold Natural History Clubs.—The gathering of the Woolhope, Worcestershire, Malvern, and Cotteswold Natural History Clubs took place at Ledbury, on Thursday, the 3rd of June, with a strong muster of members, although the unfortunate state of the weather considerably interfered with the arrangements of the day. The Woolhope Club breakfasted at Ledbury, at 9 o'clock, and afterwards proceeded to Braidlow Hill, where a meeting was effected with the members of the other societies, in all numbering about sixty. Here the Rev. W. S. Symonds delivered an eloquent discourse, taking for his subject the Malvern range, which stood prominently out from the magnificent panorama around. He systematically, but briefly, described the different changes which had happened to the ancient rocks, commencing with the Holybush sandstone, and the equivalents of the Llandovery beds, and ending with the Wenlock shales and Ludlow rocks of the group on which they were then standing. He then dwelt on the Old Red Sandstone of the country to the west of Ledbury, and the district intervening between that place and the Coal-basin of South Wales, although the dense mist creeping up took away from the effect of this part of the lecture. He finally closed with the announcement that a "bone-bed" had been discovered in the Mill Hills by two working men of the town, and recommended an exploration of it as the best arrangement of the day. The party had not gone far, however, when the threatening aspect of the sky made a retreat into the hotel necessary, and a tremendous thunder-storm speedily proved the prudence of the measure. It was therefore determined to transact business before dinner, in the hopes of the weather clearing sufficiently to allow of an excursion afterwards. The chair was taken by Dr. Bevan, of Beaufort, President of the Woolhope Club, who exhibited a series of marine fossils, including encrinites and other fossils from the Coal-basin of South Wales, accompanied with remarks on the position of the beds in which they were found, and the probable conditions under which they were deposited. Mr. Jones, of Gloucester, exhibited a gyroscope, and went through some interesting experiments connected with it. Mr. Edwin Lees then read a paper on the colouring given to nature by cryptogamic vegetation, and made some remarks on the vitality of seeds, a *quæstio vexata* which gave rise to considerable discussion, eliciting many curious facts. Mr. Curley showed a large horn which had been found in the excavations of Newport Docks. About forty-five gentlemen sat down to dinner, Dr. Bevan presiding, and Mr. Symonds taking the vice-chair. After dinner the company dispersed, some home, some to visit the antiquities of Ledbury, and others to explore the bone-bed. Amongst the number of members present were the Rev. W. S. Symonds, President of the Malvern Club, Dr. Bevan, President of the Woolhope Club, Edwin Lees, Esq., Vice-president of the Worcestershire Club, Revds. W. Thorn, J. Thackwell, R. Hill, G. Davis, J. Kent, T. Hayward, W. Prime, J. Barker, —. Smith—Captain Peyton, Messrs. Steele (Abergavenny), J. Higgins, H. C. Vernon, Herbert, Budd, J. Walker, C. Jardine, J. Jones, (Gloucester), P. Ballard, A. Thompson, T. Curling, (Hereford), R. Smith, (Droitwich), Lightbody, Cocking, (Ludlow), R. Lingwood, E. Gillam, Ponting, Chaplin, &c. "Notwithstanding the unfavourable weather," says our correspondent, "a pleasant day was spent, although there is no denying that the field-days are seldom working days, despite the formidable array of hammers and boys brought to the scene of action. We must rather look at them as pleasant meeting-points for friends, where each working naturalist may communicate the result of his labours and experience, and acquire fresh knowledge for his future guidance. Long may the clubs prosper, and bring to their numbers fresh and ardent geologists, each to contribute his item towards perfecting the noble science of geology and natural history."

NOTES AND QUERIES.

The Caverns or Loch-Holes in the Alston Lead mines in Cumberland.—The miners, in the prosecution of their labours, know nothing of these cavernous vacuities until they strike into them, as they advance in their working. The caverns are of various dimensions, from that of a nut to rooms large enough for three or four men even to move about and stand in. In these caverns numerous mineral spars are found crystallized into prismatic, cubic, hexagonal, or other figures; these crystals are generally transparent and beautiful, some of them are exceedingly pure and polished. Caverns lined with crystals are frequently met with in hard mineral veins, and such are generally called by miners "Shake-lochs," or "Loch-holes." Their magnitude is generally in proportion to the size of the veins in which they are found, and their insides frequently exhibit all the variety and beauty of the most curious grotto-work. There is commonly a hard concreted stony crust, called "Druse" or "Rider" by the Alston Moor and Allendale miners, adhering to the inside of the cavity, out of which are shot an innumerable multitude of short prismatic crystals, which sparkle like thousands of diamonds. Sticking promiscuously to these are patches of lead ore, "Black Jack," pyrites, sulphur and spar, of regular prismatic, cubic, and other figures; besides which, clusters of wildly irregular appearance often grow out of one another, until the inside of the caverns are sometimes adorned with these wildly grotesque figures, growing upon and branching out of one another, in a manner not to be described, and decorated with all the gay and splendid colours of burnished gold of the rainbow and of the peacock's tail.—John Jameson, Arlington-square.

Private Geological Collections.—"Dear Sir,—Acting up to the suggestion of my friend, the Rev. P. B. Brodie, of Rowington Vicarage, contained in his letter published in the Geologist of last month, I beg to inform you that it will afford me pleasure to show my private collection of fossils to any brother-geologist who may happen to visit this neighbourhood.—Yours sincerely, Charles Pierson, 3 Blenheim Parade, Cheltenham."

Geology of Ashby-de-la-Zouch.—To assist M. S. in his inquiry upon this subject, I may observe, that Mammatt's valuable work is very dear, and, I believe, out of print. A copy is kept for the use of visitors at the Bath Hotel, (Petter's). "Charnwood Forest" is also out of print; but a cheap and popular abridgment of it has been published by Allen of Nottingham, at 1s. 6d.; it contains Jukes' paper on the "Geology of the Forest." With respect to localities for fossils, any of the coal-pit banks of Whitwick, Snibston, Peg's Green, &c, will furnish them. M. S. has but to search among the *debris* of the pit-banks to find (more especially upon the clays and sandstones that intercalate with the coal), numerous impressions of fern leaves and stems, Lepidodendrons, Calamites, and also shells of Unio; in hand specimens I have had six together. The dolomitized Mountain Limestone of Bredon Hill, Cloud Hill, Barrow Hill, and Gracedieu, will furnish numerous casts of shells of all the leading carboniferous types, especially Orthis, Euomphalus, and Orthoceras; some of the latter have been found of the size and shape of a Stilton cheese, with central siphuncles. Large masses of coral are also found. There are some interesting fragments of Permian beds at Oakthorpe and Measham. The Permian breccia at Oakthorpe contains angular and subangular fragments of older formations, rolled fossils from the Silurian rocks and Mountain Limestone, Zoophytes, and Encrinites, all embedded in the same clayey matrix. In the valley adjoining the railway, near the Moira colliery, a singular outlier of Permian sandstone is found, locally called the "ballast-pit"; it contains numerous large fragments of silicified trees, Endogens and Coniferæ (pines). Some of the specimens are extremely hard, and consist almost entirely of silica and oxides of iron. They may easily be dug out of the soft sandstone with a small spud. A mop-stick, having a small strong piece of flat iron fastened at one end, is a very useful instrument in these geological rambles. I have some very fine specimens, and one deposited in the Leicester Museum, and another in my possession, measure 12 inches in diameter: they show the Sternbergia (cast of pith), with the discoidal spaces, medullary rays, rings of growth, the lace-like net-work round the small pithy centres, warty excretions of the bark, &c. Other specimens are entirely endogenous and look like bundles of very fine reeds, all cemented together. I should take exception to the remark that " the Syenites of Mount Sorel protruded through the slates of Charnwood." There is no evidence of this; on the contrary, what evidence there is upon this point is against this view; and I incline to the opinion that all the granites and syenites found on the flanks of the slates are of older date than the slates. They certainly did not produce the upthrow of the anticlinal, as they are not found along this line, the small patches of igneous rock marked in the maps being of a basaltic character. There is no spot where the junction of the syenite and slate is exposed, although in some places they approach within a very few yards, yet a considerable depth of red marl conceals the actual junction, and still no disturbance of the dip of the slate is found to occur at these places. The extreme south end of the anticlinal is exposed in a quarry near Hallgate, the slate dipping each way, yet touching at the top I have here obtained a fine pentagon of coarse-grained basalt; but the upheaving rock, whether basalt or syenite, does not appear to have burst through the anticlinal to any extent, merely tilting the slates up. At any rate, I think neither the syenites nor granites of Mount Sorel, Groby, Markfield, nor the phorphyritic rocks of Bardon, High Sharpley, &c., have been the cause of the upheaval of the slates.—JAMES PLANT, Princess Street, Leicester.

TRIASSIC STRATA.—The letter of your correspondent, Rev. P. B. Brodie, and his recent discovery of a fine specimen of fish from the Upper Keuper Sandstone, in the neighbourhood of Rowington, again recals to my mind the regret I have felt that the few rare fossils from this very interesting and somewhat obscure formation, are not collected at some one locality easily accessible to all geological students. The finest collection is in the Warwick Museum; another collection is at the Leicester Museum; and some specimens are at the Geological Society and at Jermyn Street Museum. I have a number of specimens in my own possession. It would, however, be much better, if any use is to be made of them in working out the palæontology of the British Trias, if they were all deposited at some one place; and this course might lead to the production of a monograph on the Trias of Britain, a great and much-felt want. Let me warn young geologists not to confound this Keuper Sandstone, which lies *above* the Red Marl, with the Keuper Sandstone lying *below* that stratum. Some allusions to this formation, that I have read, have not kept this distinction sufficiently clear. The Lower Keuper Sandstone formerly classed as No. 1 of the Bunter series of beds, and called at times " Water-stones," or " White Beds," is a very extensive formation, both vertically and horizontally, and probably will be found to be the equivalent of the " Muschelkalk," thus completing the British Triassic group. The Upper Keuper Sandstone is extremely local in its development, rarely exceeding two miles in horizontal extent, nor more than 80 or 90 feet in vertical depth. In several localities where I have examined it (although continuous for miles, running in and out in an irregular line), it is not more than from 10 to 20 yards in horizontal width, and from 4 to 12 feet in vertical depth.—JAMES PLANT, Princess Street, Leicester.

FOSSIL WHALE.—Dr. Allman, Professor of Natural History in the University of Edinburgh, recently visited Stirling to inspect some cetaceous remains excavated in a clay-field, adjoining Mr. Christie's brick-works on the shore. The whale is computed to have been about forty feet in length, and the skeleton is considered to be the most complete specimen as yet discovered in North Britain. Professor Allman recommended that the bones should be united by a qualified articulator, and preserved in a museum.—J. J., Inverness.

REVIEWS.

Mantell's "Wonders of Geology." Edited by T. RUPERT JONES, F.G.S. London: Bohn.

WHEN a book passes through six editions, and the public buy eagerly of the seventh, it must be a work of real merit. But when this demand happens long after the death of its first author, when the revision of his labours has fallen into other and younger hands, there must be as much credit due to the skill and talent of the succeeding editor as to the original inditer; especially when, as in the present case, the work appears brought up to the last point of information and existing knowledge, and stands confessedly a better book than ever.

The best popular books of a science must be few, but Mr. Rupert Jones' Edition of the "Wonders of Geology" stands in the first rank.

The two most known and widely circulated of Dr. Mantell's works were the "Wonders of Geology" and the "Medals of Creation," the former taking the strata in succession, with their characteristic fossils, and the latter constructed in accordance with the relations of the fossil organic remains, or in natural history series.

The "Wonders" was the first really popular book on Geology printed in England. Some more or less successful attempts had been made by Mr. Bakewell and others—but Mantell's "Wonders" stood pre-eminently the book of its day. How well it has held its own in the powerful rivalry of the splendid labours of Sir Chas. Lyell, and of those other excellent books of Phillips, Ansted, &c., is evidenced by that meritorious badge of honour contained on the title page—"7th edition."

To the new matter added by Mr. Rupert Jones we have already alluded, but it would be unjust not to make more special mention of some of these additions, so important as to give almost a new character to the work.

Not only have the scientific terms and words in the glossary received more correct definition, but throughout there is manifested a material improvement in this respect—and this is not a slight one. We have placed before us the new Tertiary nomenclature of Prestwich and the late Edw. Forbes, with the most recent determinations of the English Tertiary strata in their relations to each other and to foreign types, and more philosophical views of their history and formation, especially in respect to the Woolwich and Isle of Wight deposits. Again, a much more comprehensive view is taken of the Wealden beds in this than in any other of the former editions which issued under the direct supervision of Dr. Mantell himself, who, it is well known, dwelt rather too strongly and too exclusively on the *fluviatile* conditions of that group; while now, the semi-marine characters of some of the members of this group are very properly brought forward, and their due importance assigned to them.

Much in regard to the Purbeck beds was accomplished by the late Professor E. Forbes; and more recently the extensive excavations of Mr. S. H. Beckles have added many new animals to our previous lists. The essence of these labours is concisely added in the pages before us.

Then, throughout the work, the nomenclature of the fossils is vastly improved, and far more attention paid to the actual value of the natural groups or organisms in their classification. Terms are restricted to their proper meaning; and thus, for instance, we have the correct separation in the language used of the Bryozoa from the Corals, the word "coraline" being ignored in respect to one division of the Crag, which is really bryozoiferous, and contains neither corals nor corallines.

In regard to the absolute classification, we have here, too, great improvements. There is a proper classification of corals, of Diatomaceæ, distinct from animalcules, and better definitions of the Brachiopoda and of the Foraminifera than heretofore, and better botanical tables and order of grouping; and especially we may refer to the new exposition of coal-structure, derived from the observations of Redfern, Queckett, and other investigators.

In the preface to the second volume, Mr. Rupert Jones has pointed out very modestly, but very properly, some of the additions he has made in it. Among other subjects there included, are the highly interesting researches of Mr. H. C. Sorby in the microscopical structure of rocks, by which considerable light has been thrown not only on the methods and conditions of formation of various stratified rock-masses, but even more remarkably on those of the hypogene or igneous rocks, and their included and component crystals. Another topic is Mr. Prestwich's hypothetical extension over the south-east of England of the Upper Tertiary deposits, based on the discovery of casts of crag mollusca in ironstone of the "drift" on the North Downs, near Lenham.

The borings for water at Hampstead and Harwich have led to the knowledge of the existence of a subterraneous ridge, continuous, probably, from the Ardennes to the West of England; and connecting, by an upheaval of the coal-measures along its flanks, the great coal-fields of Belgium and Somersetshire. Hence the possibility of obtaining coal by deep borings along this line of disturbance, as pointed out by Mr. Godwin Austen.

Notices of the new crustacea from the Permian and Carboniferous deposits, and new forms of fish from the Upper Silurians of the Ludlow district, and of the luminous expositions by Dr. Falconer, of the zoological and geological relations of the true species of Mastodon and Elephant, ought also to be mentioned. While the public cannot but be grateful for Sir Roderick Murchison's generous permission to the Editor to anticipate in the corrected classification of the Permian and Silurian beds, as elaborated by that eminent geologist, the forthcoming edition of "Siluria."

The discovery, by Mr. Peach, of important characteristic fossils in altered or metamorphosed limestone, has served as the clue by which Sir Roderick has unravelled the obscurity which invested the vast rock-masses of the north-west Highlands of Scotland, and enabled him to place them in their true relations with the equivalent formations in Scandinavia, Canada, and elsewhere. These are also inserted by the same favour.

Last, not least, we would notice the copious index with which this edition is supplied. No part of a book is usually more neglected, and no one part is really of more essential service to the student, than a good index, affording a ready means of reference to any particular subject, which more than anything else, perhaps, tends to keep the owner in good humour with a book. So much effect has it in this way, that we are surprised it should be so commonly slurred over, and often nearly, if not entirely, omitted.

We recommend this edition to every student, and to our readers, as a work of the highest merit, and one which we sincerely desire to see, under the same accomplished direction, long maintain its popular favouritism.

THE GEOLOGIST.

AUGUST, 1858.

ON RHYNCHONELLA ACUTA AND ITS AFFINITIES.

By JOHN JONES, Esq., Gloucester.

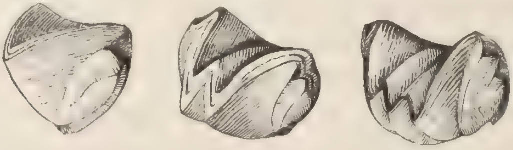
ONE of the most remarkable fossils assumed to be distinctive of a particular geological horizon, and which, from its very striking outline, most readily impresses itself upon the mind, is the *Rhynchonella acuta* of the Lias-marlstone, a Brachiopodous shell common at Stinchcombe, Churchdown, and other localities of this district, and well known elsewhere. Having paid considerable attention to the class to which it belongs, I have long abandoned the common practice of placing in the cabinet only those specimens which chance to accord with the forms figured and described as *typical.* Instead of doing this, I have selected, as good examples, those which manifestly have not been crushed or injured prior to their entombment and petrifaction; and these I have arranged in series illustrative of specific development.

This mode of procedure has taught me that the species under consideration assumes forms varying from that under which it is most generally known; and it has led me to believe that several so-called species of various authors are, in reality, mere varieties of this.

All who have attentively studied the numerous Terebratulidæ of the Cotteswolds will have experienced the difficulty of assigning satisfactorily certain anomalous forms, occurring in beds ranging vertically from the Pisolite, or even lower, to the Cornbrash, to such well-established species as *Terebratula maxillata*, *T. perovalis*, *T. globata*, or *T. intermedia*, and will remember the remarkable varieties of individual character presented by other species, as, for example, *T. plicata*, *T. simplex*, *T. fimbria*, and *T. carinata*, sufficiently striking when studied in solitary examples, but, in an extensive series, not suggestive of good and stable specific differences. The variability of character within recognized specific limits, then, being well known, I proceed to lay claim for *Rhynchonella acuta* to as great an amount of indulgence, in this respect, as for any of its congeners, referring in evidence to the specimens figured with this paper.

Its most common form is indubitably that figured by Sowerby, and other authors, which occurs in the Lias-marlstone of Gloucester and Somerset, in the Lias-marlstone and ironstone-series of Yorkshire, in France, part of Germany, in the Macigno d'Aubange, the equivalent of those deposits in Belgium, &c.; but this I shall endeavour to show in the sequel to be an immature form, and that, in the succeeding stages, the species to which it belongs attains much larger dimensions, and a higher degree of development, than in the marlstone, although in that stratum it occasionally assumes characters of importance, as regards our present inquiries, which have not hitherto been formally noticed.

For example, it sometimes presents two mesial folds, as in Pl. IX. Fig. 3, from Churchdown; and three mesial folds, as in Pl. IX. Fig. 2, from Stinchcombe. The scarcity of similar examples is, probably, not so much attributable to their rarity as to the intractable nature of the matrix in which they are imbedded, which renders the extraction of its most simple organic forms sufficiently difficult and laborious, and that of the more complicated still more so. A cursory examination will suffice to show that the examples referred to cannot be assigned to any other species than *R. acuta*, as they agree perfectly with the typical form in lateral outline, and differ from it in no other respect than in the number of mesial folds.



1. 2. 3.

1. **Rhynchonella acuta.** 2. **Rhynchonella bidens.** 3. **Rhynchonella triplicata.**

(Copied from Plate XIII., Phillips's Geology of Yorkshire.)

On comparing these with the figures of *R. acuta*, *R. bidens*, and *R. triplicata*, of Phillips, from the marlstone and ironstone-series of Yorkshire, it appears to me that that author has merely represented more aged examples of the two varieties before us as species distinct from the first-named.

Professor Morris, in the last edition of his "Catalogue of British Fossils," treats the difference of a plication, more or less, between *R. bidens* and *R. triplicata* as unimportant, although, instead of uniting these to *R. acuta*, and assigning to the three forms one specific name, he records them as synonyms of *R. variabilis*, one of the most widely-diffused brachiopods of the Lower Lias, and of which I doubt the occurrence in the marlstone of England, at least.

In certain localities, as at Frocester, a young or dwarfed form of *R. tetrahedra* constitutes the principal bulk of large masses of marlstone, and has, I think, been mistaken for *R. variabilis;* but in neither of these species can I discover any features at all suggestive of affinity with that under consideration. That Professor Morris may be mistaken is not improbable, from the fact that the two most recent writers on the Jurassic formations of England and the continent, Oppel and Quenstedt, have both found themselves somewhat perplexed as to the true affinities of these forms, perhaps, to some extent, in consequence of having adopted, without due examination, his views. Oppel, in his observations on *R. variabilis* ("Juraformation," p. 187), after stating that it is found in the Middle as well as in the Lower Lias, remarks, pertinently enough as regards the object of the present paper, that, "in Suabia it occurs particularly under the form of the biplicated variety (*R. bidens* of Phillips), which is found also at the base of the Middle Lias at Boll, Metzigen, Hinterweiler, and Balingen, with specimens possessing a *greater number of folds* (*R. variabilis* of Zieten, p. 42, f. 6, and *R. triplicata* of Phillips.)

Bearing in mind the fact that *R. variabilis* of Zieten is not the typical form recognized by Schlotheim or Davidson, it is clear that Dr. Oppel considers the forms just described as belonging to one species, and, in his observations on *R. variabilis* of the Lower Lias (p. 121), he appears disposed to limit its stratigraphical range to the Lower Lias only, in which case, of course, they are not varieties of the latter.

Professor Quenstedt, in like manner, in his recently-published "Jura," treating of *R. bidens*, Phillips, seems disposed to consider it and *R. triplicata* as varieties of *R. acuta*, distinctly pointing out their general resemblances; although German authors generally agree in stating that this species does not occur in the Suabian Alps.

Not to needlessly multiply quotations, I may yet briefly state that Davidson, in his Monograph on British Jurassic Brachiopoda, figures what he considers to be the *R. bidens* and *R. triplicata* of Phillips as varieties of *R. variabilis*, which he believes to range through the Lower and Middle Lias;* but, unless his figures are taken from the original specimens of Professor Phillips (and these were very ill drawn by the last-named gentleman), I discover nothing in his observations upon either species to modify the conclusions at which I have arrived from a comparison of the observations of all these authors.

Labyrinthine as appears to be the confusion of ideas in the statements cited, the clue appears to me to lie within grasp. Let us remember that the three forms, in one case, occupy the same zone, occasionally occurring together, at other stages or places one or other numerically preponderating; that the difference between *R. acuta* and *R. bidens*, in the opinions of authors and observers in every way entitled to respect, is no greater than between the latter and *R. triplicata*, being one of degree only and not of kind. The suggestion, therefore, naturally arises that they may really pertain to one species. Assuming that we are justified in arriving at this conclusion, all difficulties vanish. We simply learn the not uninteresting facts in its natural history—that the geographical distribution of one of the most characteristic shells of the stage to which it belongs was co-extensive with that of many of its usual companions, from which it would otherwise appear to be somewhat unaccountably separated; and that, in particular portions of the area which it occupied, it attained to degrees of development denied to it in others.

Having pointed out instances of the confusion of these varieties with species of lower stratigraphical range, I will now direct attention to one instance of *R. bidens* having been recorded as occurring in a bed higher than that in which it is usually looked for.

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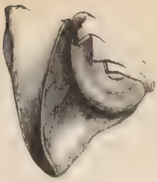
* In this monograph, Mr. Davidson gives his reasons from considering R. bidens and its synonym R. triplicata, as specifically different from R. acuta. His statements on this subject should be referred to.—Ed Geol.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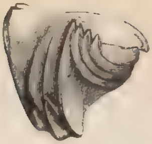
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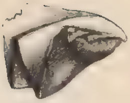
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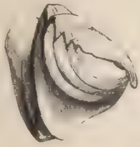
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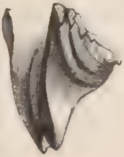
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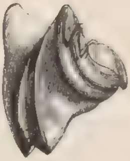
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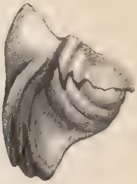
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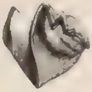
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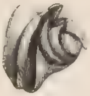
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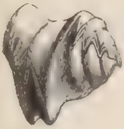
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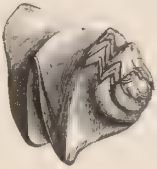
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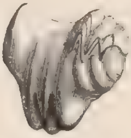
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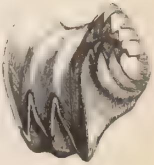
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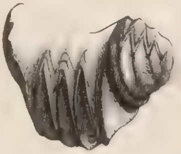
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S. J. Mackie Del

RHYNCHONELLÆ

In the Collection of J Jones, Esq of Gloucester

Figs. 1--3. Rhynchonella acuta, from the Lias Marlstone
Figs. 4—9. Rhynchonella cynocephala, from the " Cephalopoda-bed."
Figs. 10—14. Rhynchonella cynocephala, from the Upper Lias Sand

In Phillips's "Geology of Yorkshire," this marlstone shell, there first figured and described, is stated, at page 157, in the list of organic remains of the Inferior Oolite, to have been found by Mr. Ripley in the Dogger, at Glaizedale. I have little doubt that, had Mr. Ripley's specimens been submitted to Cotteswoldian geologists, they would have been named *R. cynocephala,* and the close resemblance of certain forms of this shell to the former, which induced a practised observer to consider both specifically identical, suggests the expediency of inquiring whether they may not really be so.

Mr. Lycett finds *R. cynocephala* in the marly beds lying at the base of the sands which, in this district, usually rest upon the upper Lias, as at Nailsworth and elsewhere, although it has long been considered peculiar to the "Cephalopoda-bed" above those sands. It abounds at the Horsepools, Haresfield, and Frocester, where it presents three similar degrees of variety, attained to by those *R. acuta* in the marlstone. From the thin ferruginous earthy band dividing, at Haresfield, the "Cephalopoda-bed," into two portions, they are most readily extracted; the specimens are all more or less stunted in growth as compared with those from above or below; and there principally I have found the acute variety. The only recognizable feature of distinction between this and *R. acuta* is, that in the former the apex is not so much elevated, and is formed by a less acute angle than in the latter, approximating more nearly to its younger forms; although this difference of outline may partly be accounted for, by the fact that the marlstone, in the one case, only affords us casts, through the intractable nature of the matrix, while, in the other, the shells are exceedingly well preserved, exhibiting clearly lines of growth and perfect details of the states of maturity at which they had arrived.

With so great a constancy of form to a limited set of specific types as to perplex us, and to render essential the considerations of stratigraphical position in separating them, and with these derived from beds almost immediately following each other, it is not clear that valid grounds exist for their separation. All these forms indisputably have the same vertical range; they differ in no greater degree from each other than do the varieties of other universally acknowledged species. They appear and disappear simultaneously in strata of which they are everywhere some of the most remarkable fossils, and in which they are not associated with others that resemble them so much as to justify the confusion of nomenclature which has hitherto prevailed with regard to them. Why, then, should we make four, if not five, species of that which is one only? It is not pretended by naturalists that the difference of a fold or two in shells of this genus marks more than a difference of age or of development; hence, assuming the foregone conclusions to be correct, I venture to state that neither of the forms noticed by the authorities cited, represents the full and perfectly developed condition of this species.

In a certain portion of the usually unfossiliferous sands near Painswick, intermediate to those beds in which *R. acuta* first becomes known to us and those in which *R. cynocephala* disappears, specimens occur with the latter, by no means rare, which, on the principles I have endeavoured to elucidate, must be referred to the same species. These specimens not only attain to a much greater size, but assume three or four mesial folds as their most common number. I have not found them elsewhere, nor have I seen them in any other collection than my own; but this happens probably from their having been considered unworthy of retention, on account of the imperfect state in which they are usually found.

I would remark, in conclusion, as lending additional force to my observations, that Mr. Hull considers the Terebratula which occurs so abundantly in the Frocester and Haresfield beds* with *R. cynocephala* to be identical—and Mr. Davidson has, I believe, adopted this view—with *T. punctata*, a shell which occurs in the marlstone associated with *R. acuta;* we cannot, therefore, be surprised, from their manifest community of habit, that these two species should have gone through time together, from the period of their first creation to that of their final extinction.

I trust that these observations on the natural history of an extinct Brachiopod may not have seemed tedious: but I believe every true geologist will appreciate any endeavours to clear up errors or confusion, however small, with regard to any of his "time and tide" marks; while the possible demonstration of the wide divergence of varieties from their assumed types, as exemplified in this ancient species under varied conditions of existence, may not be devoid of interest to the physiologist in his investigation of phenomena of a similar nature.

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* *R. rimosa and R. furcellata*, also middle Lias shells, have been found in these beds by Dr. Wright, of Cheltenham, and myself.

BRITISH FOSSILS, STRATIGRAPHICALLY ARRANGED.

By John Morris, F.G.S.

I. PALÆOZOIC SYSTEM.

(*Continued from page* 286.)

The following table affords an approximate numerical estimate of the genera and species of Silurian fossils within the British area hitherto, described.

	Longmynd Rocks.		Lingula Flags.		Llandeilo and Caradoc.		Llandovery and May Hill.		Wenlock and Ludlow.		Tilestones.	
	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec.	Gen.	Spec
Plantæ ? - - - - -	2	3	2	2	4	5	1	1	3	4	2	2
Amorphozoa - - -	...	...	...	...	2	2	...	...	3	3	...	...
Zoophyta Anthrozoa	...	...	...	...	12	18	8	14	31	72	...	...
Zoophyta Hydroidea	...	...	...	...	4	26	1	1	2	3	...	...
Echinodermata - -	...	. .	...	...	10	19	2	2	25	50	...	...
Annellida - - - - -	2	3	1	1	10	18	2	3	4	7	...	...
Crustacea - - - - -	1	1	6	10	36	116	12	15	19	44	5	14
Bryozoa - - - - -	1	...	1	1	7	12	3	4	8	18	...	...
Brachiopoda - - -	...	...	2	3	12	96	9	50	16	87	1	1
Monomyaria - - -	...	...	...	...	3	16	1	5	3	17	...	...
Dimyaria - - - - -	...	...	...	...	11	33	8	16	16	56	...	...
Gasteropoda - - -	...	...	...	...	13	36	12	24	11	37	1	1
Heteropoda - - -	...	...	...	...	1	9	1	5	1	6	..	...
Pteropoda - - -	...	...	...	...	4	10	3	3	3	5	...	...
Cephalopoda - - -	...	...	...	...	5	38	6	15	6	40	...	...
Pisces - - - - - -	...	...	...	...	...	...	...	..	5	9	3	5

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[Note.—The principal abbreviations used in the above references belong to the following works:—A. N. H., Annals of Natural History; G. J., Journal of Geological Society; G. R., Geological Report, &c., *Portlock*; M. G. S., Memoirs of Geological Survey; P. F., Palæozoic Fossils, *M'Coy*; P. N. Y., Palæontology of New York, *Hall*; S. S., Silurian System, 4to.; Sil., Siluria, 1858, *Murchison*; S. F., Silurian Fossils, *M'Coy*.]

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(*To be continued.*)

THE OYSTER CONGLOMERATE BED AT BROMLEY, IN KENT.

By George D. Gibb, M.D., M.A., F.G.S.

There are many localities around London which possess features of interest to the geologist, that can be reached and examined on a single day. Such a one is the pretty little town of Bromley, in Kent, with a population of 4,000 souls, at a distance of ten miles from London Bridge, and now within easy reach by the Mid Kent Railway, only just opened. A mile to the north-east of Bromley is Sunderidge Park,* in which is to be seen a section of the well-known oyster-conglomerate rock, in a large pit which, together with the accompanying shingle, has been quarried for various purposes for many years. This spot is noticed by Dr. Mantell in his charming volumes, as one of the most interesting localities he was acquainted with. At and around Bromley is an area of some extent, formed by the Lower London Tertiaries; a small patch of chalk, however, crops out to the east of the town, in which are some ancient quarries. One of these possesses some interest from being underground, and containing, as I was informed, several intricate windings.

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* The property of Mr. Scott. His steward, Mr. A. Black, has obligingly furnished me every assistance towards examining the oyster-bed on each occasion of my visit to Bromley.

The London clay, with the underlying plastic or Woolwich clays, and Thanet sands, constitute the lower division of the Eocene strata of the Tertiary group of rocks. The London clay extends over several counties of England, constituting a large part of the soil of Essex, nearly the whole of Middlesex, and portions of Berkshire, Surrey, and Kent.* In the last two counties it more especially occupies the northern parts. The plastic or mottled clays and sands which underlie the London clay are seen in the Isle of Wight in contact with the chalk, or in the London basin at Reading, at Blackheath, Woolwich, and Bromley. These clays and sands have been well described by Mr. Prestwich, and termed by him the "Woolwich and Reading Series," and the Thanet sands of the Lower London Tertiaries. However much the other divisions of the Eocene strata may have differed in their mineral character in the deposits of England and Paris, Sir Charles Lyell has well observed that there is an exception to the general rule in the plastic and mottled clays of this lower division of the Eocene series; for whether it is studied in the basins of London, Hampshire, or Paris, we recognise everywhere the same mineral character. "This uniformity of aspect must be seen in order to be fully appreciated, since the beds consist simply of sand, mottled clays, and well-rolled flint pebbles derived from the chalk, and varying in size from that of a pea to an egg."†

These characters are presented by an examination of the oyster-bed near Bromley, which consists of a series of thin layers of sand and pebbles, and an extensive deposit of oyster and other shells. In some parts the latter have formed with the pebbles and sand a distinct conglomerate, several inches thick, the cementing medium being calcareous, and apparently derived from the shells themselves. This conglomerate has been extensively quarried at one time, and even now many of the houses, grottos, and garden-walls in Bromley are built with the rock thus ornamented with the shells, which are so naturally grouped together as to appear almost to have been artificially imbedded, so as to expose their general character. Many of these shells I have obtained in a perfect state, but a large proportion of them are broken and scattered throughout the deposit. One of my specimens consists of a mass of about six oyster shells attached to a large oval flint-pebble, which evidently have grown on their original site without injury from the neighbouring pebbles. Dr. Buckland had in his collection a specimen in which five oyster shells were affixed to the opposite sides of a large kidney-shaped pebble, from which he inferred the existence of a state of sufficient tranquillity for the shells to live and die undisturbed in the midst of these pebbles.* All these pebbles—the shingle that formed the native bed of the shells—are of a black colour, are well worn and rounded, and exist in countless thousands in this pit, and are scattered throughout the neighbouring land for many miles; they illustrate very forcibly the immense scale in which the aqueous destruction of the superficies of the chalk was carried on, and, as geologists correctly assume, the long period of time which intervened between the deposition of the chalk and that of the plastic clay.

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* Geology of England and Wales, by Conybeare and Phillips.

† "Manual of Elementary Geology," p. 221. Fifth Edition.

The pit in which this deposit can be well seen and studied is situated to the south of a hill, into which the excavation runs in a northernly direction, and varies in depth from 40 to 60 feet. The strata of sand and shells are seen to advantage on the left of the entrance, and dip towards the north-east; the upper layers, however, occupying the north half of the pit, dip at an angle of twenty-five degrees, whilst those at the south half, which are lower down in position, dip at an angle of twelve degrees. The lowest stratum consists of a light gray or drab sand, uniform in colour, free from pebbles or shells, and averaging twelve feet in thickness; upon this is a conformable layer of light brown sand, twelve inches thick, filled with myriads of the fragments of small shells. Next succeeds a lighter sand with small rolled flint pebbles, and of small, very friable shells of the genus Cyrena and Cerithium, sixteen inches thick. Variegated brown sands with very few pebbles next succeed, from three to four feet thick, over which is a bed of brown sand and pebbles, free from shells, in layers thinning out, but in the middle fourteen inches in thickness. Light brown and variegated sand, with a few pebbles and a few shells, also thinning out, succeeds to the last, the thickness not exceeding two or three inches. Then follows the oyster-conglomerate, mixed with rolled flints of various sizes, from that of a pea to a potato, varying in thickness from three to fourteen inches, upon which succeed thin layers of sand and pebbles for three feet, and lastly, the gravel, which varies from two to twelve and eighteen feet in depth. These are better represented in the following table:—

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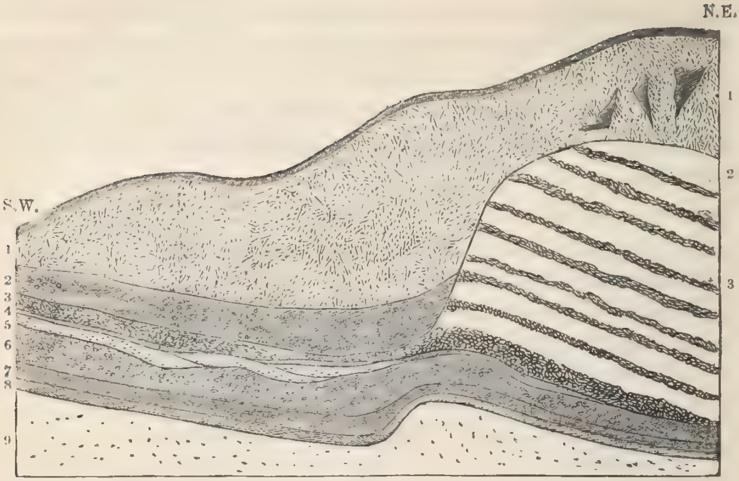
* Geol. Trans. Vol. 4, p. 300.

	Ft.	In.
1 Gravel ——— two to twelve feet and	18	0
2 Layers of sand and pebbles	3	0
3 Oyster-conglomerate, mixed with small and large rolled flints, varying from three inches to	0	14
4 Light brown and variegated sands, with a few pebbles and a few shells, thinning out ——— two inches to	0	3
5 Brown sand and pebbles, free from shells in layers, also dying out	0	14
6 Variegated brown sand, with a few pebbles ——— three feet to	4	0
7 Very light brown sand, with small pebbles and shells	0	16
8 Light brown sand with fragments of small shells	0	12
9 Light grey uniform sand, averaging	12	0

In that part of the excavation, situated towards the north, and which is at the same time the most elevated, the surface is a mixture of drift, sand, and chalk-detritus, overlying layers of sand and plastic clay forming the conglomerate. The depth of this drift may be from six to eight feet, and corresponds with the beds 1 and 2 in the foregoing table. Then for twenty-five feet are seen layers of sand and pebbles alternating with the oyster conglomerate rock, in which multitudes of shells are found forming a hard sort of breccia, which varies in thickness from six to eighteen inches; and, in some places, consisting wholly of pretty large or of small rolled flints, and in others wholly of masses of oysters; in others, again, of myriads of small shells, some in fragments, and others quite perfect, but very friable. In some of the layers, the conglomerate has assumed the characters of a distinct sandstone, and is extremely hard; and when it consists of small pebbles, forms a pudding-stone. To these succeed the layers marked 4 to 9 in the table, but they were not completely exposed in the northern part of the excavation. The annexed diagram gives a section of this place.



Section of the Oyster-deposits at Sunderidge. The figures refer to the table of strata at page 327.

Of the *shells* which enter into the formation of this conglomerate, the great bulk are oysters, many specimens of which are found with the valves closed, others with them open, whilst multitudes of single valves abound, a few covered with *Vermilia* and *Serpula* on both surfaces, and exhibiting also perforations of Clionidæ. The interior of most of the closed oysters is occupied by a lining of carbonate of lime, from one to three or four lines in thickness, leaving a central cavity; the internal surface of which is studded with very small dog-toothed crystals of calcareous spar. This phenomenon I noticed also in many angular cavities in the rock itself, alongside of other imbedded shells. Many of the oysters resembled the common edible species of the present day, whilst others were thick and massive with a large and wide hinge; some of the latter I measured 5½ inches long, and 4½ wide. Many specimens were adherent to a single pebble, three or four commonly, and the mass which I have already referred to had six perfect oysters attached to a large pebble, besides about nine different valves of dead specimens adherent to the pebble and to one another. On the upper valve of one of the perfect oysters, four young ones, about half an inch wide, are attached, and quite perfect, a circumstance which especially points to their having grown on the spot. Nevertheless, I would infer that many of the oysters were strangers to the spot on which they are now found, from the very great preponderance of single valves over the perfect shell, as well as finding many of the latter in over-turned positions. The following are the fossils which I obtained from this excavation; there are other species of *Ostrea* and *Cerithium* besides those named:—

Ostrea bellovicina.
,, edulina.
Cyrena cuneiformis.
Cerithium variabile.
Pectunculus Plumsteadiensis.
Modiola Mitchelli.
Serpula vermicularis.
Vermilia triquetra.
Perforations of Clionidæ.
Minute scales of fish.
Indistinct traces of plants.

At the railway cutting, a quarter of a mile to the south-west of Bromley, a section of the same deposits is to be seen running through two high hills, consisting of gravel, layers of sand, and shell breccia, but the last consists of small shells, with comparatively few oysters, and not so many rolled flints at this spot. Throughout the whole of Bromley, on digging for wells, this conglomerate has invariably to be reached before water can be obtained; one well shown to me gave a section of two feet of loam, two feet of gravel, twelve feet light grey and brown sands, and seven feet of oyster-conglomerate; a plentiful supply of water had been reached at this depth. This occurs when the dry and hard rock, especially at the surface of the conglomerate, has been cut through.

The Lower London Tertiaries are divided into three sub-groups by Mr. Prestwich, the upper one, which is called the "Basement-bed of the London clay," is a marine deposit, resembling the beds beneath it in mineral character, but in organic life more nearly related to the London Clay above it. The middle sub-group, or the "Woolwich and Reading Series," is a very variable group of freshwater and æstuarine origin. The lower sub-group, or the Thanet sand, is a marine bed of much less extent than the other two. These three groups are ably described in the third lecture of Mr. Prestwich's, "The Ground Beneath Us."*

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* Visitors to Bromley can avail themselves of the services of Mr. Porter, the enterprising landlord of the "Rising Sun," who will undertake to pilot them to the railway-cutting, the rock-pit, and the underground chalk-quarry.

NOTES OF A GEOLOGIST IN IRELAND DURING AUGUST AND SEPTEMBER, 1857.

By the Rev. W. S. Symonds, Rector of Pendock.

(*Continued from page* 296.)

On leaving Dublin, we travelled northwards, for the purpose of examining the carboniferous rocks, and visiting the magnificent collection of fossil-fishes in the museum of the Earl of Enniskillen; we then journeyed south for Killarney and the Dingle district, but as it may be more convenient to the reader to travel *geologically*, we will reverse the order of our journey, and visit the Upper Silurian and Old Red Sandstone districts before we examine the carboniferous deposits.

The lower Cambrian rocks of Wales, of which the Oldhamia-schists of Ireland are believed to be the equivalents, pass upwards by insensible gradations into the Lingula-flags, to which they are altogether conformable. The Lingula-flags are reckoned to be four or five thousand feet thick, and the Llandeilo or Builth-beds, which cover up these, are probably as thick; but geologists are, as yet, uncertain whether they possess in Ireland any true equivalents either of the Lingula-flags or of the Llandeilo and Builth deposits. There are, however, fossiliferous rocks of the Bala and Caradoc age in Ireland similar to those which, in Wales, succeed conformably to the Llandeilo and Builth beds, and they may be examined at Courtown, in the county of Wicklow, and again at Tramore, south of Waterford. They are unconformable to the rocks below, which are undoubtedly Cambrian, and thence, we imagine, has arisen the suspicion that the Lingula-beds and Llandeilo-flags have never been deposited in Ireland, or that if they were, they have been denuded and swept away before the deposition of the Bala or Caradoc strata. This part of the geology of Ireland is very unsatisfactory, and local geologists appear to know very little respecting the history of the Lower Silurians.

For glorious physical geology and picturesque scenery, commend me to the Reek district beyond Killarney. The geologist should examine carefully the phenomena of the Dingle promontory and the neighbourhood, and return by the Macgillicuddy's Reeks to Killarney. The Dingle peninsula has been called the key to the geology of the south of Ireland: it may be the key, but the lock is one difficult to open—the amount of contortion and twisting in the rocks of that coast is extreme; but for the minutiæ of detail, we refer the traveller to the maps and printed papers of the gentlemen attached to the Geological Survey of Ireland.

In the west of England, the Bala or Caradoc-beds are overlaid by the May Hill or Llandovery rocks, which are really the base of the Upper Silurians, and it is said that a portion of this May Hill Sandstone group underlies the representatives of our Wenlock and Ludlow rocks at Dingle. In Galway, on the shores of Lough Mask, and at Ughool, in the county of Mayo, my friend Dr. Melville informs me that Ireland furnishes, what he considers to be, the exact equivalents of our English May Hill deposits, and their passage upwards into true Wenlock deposits. That the Dingle promontory contains the representatives of the Wenlock and Ludlow rocks, we cannot doubt. The uppermost Silurian beds are overlaid by the Glengariff-grits and Dingle-beds, which are estimated by Professor Jukes and Mr. Du Noyer at the enormous thickness of 10,000 or 12,000 feet.

The red slates which cover up conformably the upper Ludlow deposits with Pentamerus Knightii, must be the Irish representative of the English Tilestone group; and the overlying Glengariff-grits and Dingle slates are, we imagine, the local representatives of our masses of Cornstones and Brownstones, which are so well developed in the Brecon Van district, and in the cornstones of Herefordshire and Brecon, and which, with the Tilestones, I believe to be rightly denominated by the good old term of "Old Red Sandstone." Thus we have in the Dingle rocks, 1. Upper Silurians. 2. Tilestones. 3. Glengariff-grits. 4. Dingle-beds. The tilestones are red slates and sandstones, the Glengariff-grits green and purple grits with red and greenish slates, and the Dingle-beds consist of red sandstone and slates with thick beds of conglomerate, which contain pebbles of Silurian limestone and fragments of hornstone and jasper. Now, over all these beds are deposited, unconformably, red sandstone and conglomerates, which are, I have no doubt, the representatives and correlatives of our English red sandstone and conglomerates, which overlie our Upper Cornstone series or Brownstones, and are, in some instances, as at Dean Forest and on the Blorenge, unconformable to the Brownstone below. This so-called "Old Red conglomerate" in England and Scotland passes upwards conformably into the yellow sandstone and carboniferous shales, and such is the case in Ireland, yet to this carboniferous mass of sandstones many of the Irish geologists would restrict the "Old Red Sandstone." We cannot agree with this arrangement, inasmuch as the "Old Red Sandstone" of Hugh Miller described the fossil fishes of the tilestones, cornstones, and brownstones, of which we believe those unfossiliferous rocks of Kerry are the equivalents.

Dunmore Head, the most western point of the continent of Europe, is a scene full of grandeur, and from it, on a clear day, Valentia and the storm-beaten Skilligs are visible. Ferritur's Cove, which furnishes abundance of Silurian fossils, is eight miles N. W. of Dingle; the rocks there assume the most fantastic shapes, and the human associations of this wild spot with its ancient Spanish settlement, are as interesting as its geological records of a Silurian ocean. At Clogher Head to the south, a greenstone dyke traverses the strata, and at Doonguin, six miles west of Dingle, there is some very queer physical geology. Ballyoughteragh (Sybil Point), seven miles N. W. of Dingle, Ballinahow, seven miles north of Dingle, and Kinard, four miles S. E. of Dingle, furnish sections with unconformable carboniferous ("Old Red?") conglomerate resting on brownstone. There is good study for the geologist between Sybil Head and the east flank of Slievemish Mountain, where the yellow (carboniferous) sandstone comes on; and again from Brandon Head to Bulls Head, is the longest and most instructive section of the peninsula. The mountain of St. Brandon towers to the height of more than 3,000 feet over the Atlantic, and takes its name from the patron Saint of Kerry. Near Smerwich Bay, and at several other places, the traveller meets with much antiquarian lore in the old Christian oratories, which well repay a visit. Having examined the Dingle district, we recommend the geologist to journey southwards, by Killorglin, for the Macgillicuddy's Reeks. Killorglin is a dirty Irish town, and the flat country eastward consists of coal-measure clays; the carboniferous limestone cropping out near the village. We took up our quarters at Breen's Hotel, at the south extremity of the picturesque Lough Cara, from whence we made excursions among the lakes and mountains. The traveller must not be misled by the title "hotel," for Mr. Breen's *hostel* is only a moderate little inn, with excellent quarters for the sportsman or naturalist, who will be contented with fresh fish and Kerry mutton. The scenery around Lough Cara is even more beautiful than that of the far-famed

Killarney; for to the rich glow of verdure and exquisite combination of colour, which makes Killarney so justly famous, Cara unites the wildest hill-scenery in Ireland. In geology, the district represents the fans of Brecon, but the mountains are higher, more rugged, and retain on their weathered sides and surfaces deep furrows and scratches, and innumerable boulder-rocks, the sure sign of ice and glacier action in days long since past.

Walking among these hills is most fatiguing, owing to the boulders which cover the sides; and it is quite necessary to warn the traveller against being overtaken by night, when it becomes absolutely dangerous. We ascended one of the highest mountains of the "Black Valley," and all the way from Lough Cara we observed that the dark, heather-covered moors were studded with innumerable blocks of grey rocks, which had been rent from the mountain side, and were dropped by ice-rafts floating out to sea by way of the Lough Cara Valley. The head of the Pass into the Black Valley must have been the actual bed of a large glacier which filled up the valley, and has left long lines of débris, marking the old moraines.

Seated on the crest of a deep ravine, facing the King of the Reeks (Carran Tual), we looked over the wildest scene we ever beheld in the British Isles. Around us, on the hill summit, all was desert-like and lonely; not a sound was heard save the bleating of a distant goat; and at our feet lay a dark, deep valley, covered with grey boulder-stones, whence a shroud of mist was rising, and which might well have furnished a painter with a subject for the Valley of Death. And the sun shone upon hill rising above hill, with bold rocks intermingled with the purple blossom of various heaths and the bright yellow of the gorse; while in the distance gleamed a lake, and here and there were scattered a half-ruined chapel or smoking hovel. Crossing the platform on the summit to the eastern edge, we looked down upon the outlet of the Black Valley and the Lakes of beautiful Killarney, the headlands of the Reeks and the mountains of Dromore stretching away on either side, while a short walk in the opposite direction gives a magnificent view of Bantry Bay, with the Islands of Scara and Dursey, dim and distant. The march homewards also required many a halt among scenes of solemn and imposing character.

Descending the hill-side we observed specimens of the *Saxifraga umbrosa*, though not in flower; also in marshy ground the leaves of

Pinguicula grandiflora, which we would have given somewhat to have seen in blossom. *Sibthorpia Europea*, one of the Scrophularineæ, is said to have been found in the district, as well as on Common Hill, near Dingle. There is much food for thought on those geological phenomena which affect the distribution of plants, by changing the physical conditions of regions, altering the climate, and various other causes; and we could not but reflect upon that far distant time, of which the Brownstone (Upper Cornstone of the Old Red) on the summit of the hill, is a representative, a period of which we know but little of the vegetation of this plant, and that little is dim and obscure. The Upper Silurians had their club-mosses, which is all we know of the history of the earth's terrestrial vegetation when those beds were deposited. But the Upper Cornstones of the Kerry mountains represent a period that, geologically reckoning, could not have been very long anterior to the wonderful vegetable epoch that produced the Paleozoic coal. During the deposition, in the sea, of those Brownstones, which are now elevated into hill ranges, it is not improbable that noble Conifers, with tall Lycopodiaceæ and gallant Ferns, flourished on the land at no very distant spot, when the grits and sands of the Brownstones of Ireland and the Eurypterus-beds of the Upper Cornstones of Herefordshire were accumulating beneath the waves of the Old Red Sandstone sea. The floras of the earth, like the ancient animals, appear to assume a higher type of organization as we ascend in the history of geological formations, and approach the present time; nevertheless, animals and plants are constantly being detected in strata where, a few years since, their occurrence would have been deemed an impossibility. Mr. John Miller, of Thurso, possesses a large collection of Old Red Sandstone plants; similar specimens have been found by Mr. Peach, at Wick, and Dr. Hamilton, in Orkney; and similar fragments are found abundantly in the Upper Old Red of the south of Ireland. A fossil fern has been discovered in Orkney, and is described in the "Testimony of the Rocks" (pp. 25); in short, in the words of Mr. Salter, we possess in "an era as far back as the middle Devonian (Cornstone series) a vegetation of considerable importance."

These ancient floras have passed away, and the vegetation of the Old Red and Carboniferous epochs which once clothed the lands of these latitudes, is only to be found in the records of the rocks. As extinct animals were replaced by newly-created forms, so does it appear to have been with the vegetable world; and the fossil-botanist informs us that we may not date the epoch of the oldest species of existing plants as anterior to the Eocene period. And here the phenomena of the flora of the west of Ireland give rise to some interesting speculations, in which the saxifrages and heaths we see around are intimately concerned. The most profound naturalist of modern days, Professor Edward Forbes, in his endeavours to trace the origin of the flora and fauna of the British islands, arrived at some very remarkable conclusions respecting the Iberian flora of the west coast of Ireland. The British flora is divided by Forbes into five great groups—the Iberian, the French, the English, the Alpine, and the Germanic; and to explain the origin of the Iberian flora, with which we have to deal, Professor Forbes believed that a great continent was formed by the upheaval of the Miocene tertiaries, which extended far into the Atlantic; and that this tract bore the peculiar fauna and flora now known as the Mediterranean, fragments of which are still met with isolated in the Azores, Madeira, the Canaries, as well as in Ireland, and on the Spanish peninsula. Thus Forbes believed that the saxifrages and heaths of Kerry and Connemara are the survivors of this ancient flora—flowers far older than those of any of the other four floras—flowers which bloomed when the west of Ireland was geologically united with the north of Spain, and which have survived even the great climatal changes of the glacial epoch. If this hypothesis be correct, the saxifrages and heaths of this western coast will probably be the oldest survivors of the last floral changes upon the plant's surface. Verily, with "Old Red" mountains, ancient glaciers, and plants still in existence that probably flourished when the west of Ireland was a portion of an old Miocene continent, we had much to think of, although the route back to Breen's peat fire and Kerry mutton was rough and weary.

(*To be continued.*)

A RAMBLE ROUND LUDLOW.

By George E. Roberts, of Kidderminster.

After the *al fresco* dinner of the "Worcestershire Naturalist Club," under the Sorb Tree, in Wyre Forest, I and Mr. Baxter of Worcester, well known for his botanical acumen, started for the Ludlow promontory, *via* Cleobury and Caynham. I copy from my note-book the following geological facts—some may be of use to the definer of the limits of ancient life-periods; others, deficient in value for such purposes, may save future explorers time and trouble in working up the district.

I arrange them in the order of their occurrence.

The "Brownstones" of the cornstone series are finely quarried a mile east of Cleobury; very fine rippled-marked slabs may be obtained, and ichnites (fossil footprints) should be apparent, it being an equivalent bed to the one in which they occur at Puddlestone, Herefordshire.

The curious outlier of the "Forest Coal-field," on which Cleobury stands, has been fruitlessly sunk into for coal this year; another proof that the geologist is not "abroad" in the land, no bed in the whole coal-field having paid expenses, and, in some instances—this I find among the number—the Old Red has been reached without coal being met with.

The south end of the Titterstone Hill, presenting a fine escarpment of mountain limestone to the valley, is very barren of fossils. I could not meet with or hear of any of those interesting fish-jaws, spines, and palatal teeth, so numerous along its northern sides at Oreton and Farlow. Neither did the yellow sandstones, dipping beneath the limestone, yield any trace of *Holoptychius* or *Pterichthys;* they are here well exposed, but very gritty, and more irregularly bedded than at Farlow. Sir R. Murchison notes, in "Siluria" a fin-spine of Ctenacanthus from Gorstley Rough, a mile N.W. of this place, but it would seem a solitary instance of what may be obtained in plenty at Oreton.

Our excursion thus commenced badly, for though my companion, ecclesiologically inclined, sought the church at Corley, he retired, disgusted with such an example of "early churchwarden-art."

Through the Upper Ludlow of Caynham we reached Ludlow. The Caynham beds are coloured, in error, as Wenlock in the Geological

Survey map; and it would be well if other alterations were made in it. There should, perhaps, be some distinction in colouring between the Upper and Lower Ludlow—beds so different in lithological and palæontological character. The Aymestry limestone is well laid down, but, excepting the interest of its position, few geologists care to work it—the shales above and below yielding finer and more valuable fossils. Perhaps no palæozoic district is better worked than that of Ludlow; certainly none better pays for labour, nor can exceed it in features of interest.

I found Messrs. Cocking, Marston, and Lightbody courteous as ever, and ready to "post up" the wandering geologist in the additions and alterations which their discoveries are, almost daily, bringing to pass.

Within an easy distance of the town lie the whole series of Silurian and Tilestone beds. It is to the latter that attention is now more particularly directed; the remarkable forms of ichthyic and crustacean life which they contain are valuable, not only in themselves, but as throwing a light upon their cogeners in the "Old Red." It appears likely to me that this typical "Old Red" of Herefordshire will ere long be included in the Tilestone series; for in that remarkable fish-bed which lies on the top of the cornstones of the Wall Hills, Ledbury, the *Pteraspis* and the *Cetiocaris* of the earlier beds are found associated with *Holoptychius*, the earliest true carboniferous fish. Palæontologically we may have to accept this as a boundary line between the groups. I could not learn that this fish-bed has been met with elsewhere.

Foremost in the Ludlow geology, stands the Upper Ludlow fish-bed; this has been often described; its "brown-gingerbread" structure, charged with the scales and broken-up spines of small predatory fishes, and having a great resemblance to a mass of the broken elytra of beetles, is well known to all lovers of Silurian beds. Four feet above this, a *Trochus* (*Helicites*), and *Beyrichia* (*Klœdeni*) bed is met with. This interesting little crustacean is the *B. tuberculata* of the Memoirs of the Geological Survey. This is the Downton Sandstone. Higher still is a well-marked fucoidal band. Then upon thirty feet or more of Downton Sandstone lie the transition shales, exposed along the railway-banks, and at the Paper Mill. This is a bed of high interest, and has a wide and interesting range of fossil contents.

Its fish and crustacean remains comprise *Pterygotus*, *Cephalaspis*, *Auchenaspis*, *Ceratiocaris*, *Eurypterus*, while *Beyrichiæ* and that other little curious bivalved crustacean, *Leperditia* (*marginata?*), are abundant on the surface of the shales. Here is also a fish-bed, crowded with tuberculated scales and spines of minute fishes (*Plectrodus?*).

These beds are, in their turn, covered up by the tilestones, of which the upper series is finely exposed along the sides of Carve Dale, at Bouldon, Sutton, and Norton. The latter place has lately yielded *Pteraspides*, of great interest, in the equivalent of the Trimpley-bed. *Pteraspis Crouchii* is a new form from this place, named in honour of the discoverer, the Rev. J. F. Crouch, of Pembridge. With the lower tilestones I had not time to make acquaintance, if they are exposed near Ludlow; the "micaceous red marl" of the Geological Survey Map, marked as occurring on the South flank of Llanwen Hill (near Knighton), appears to belong to this series, and to be the equivalent of beds covering up Downton Sandstone at Abberley, (N. end of the hill), and, in my own neighbourhood, of the lowest tilestones exposed in the anticlinal ridge of Trimpley.* In this micaceous marl of Llanwen, I met with *Ceratiocaris* spines. It there rests against Downton Sandstone, of remarkably hard character, containing the usual fossils.

Beneath the Ludlow "bone-bed," the Upper and Lower Ludlow Rocks are in the whole district, W. and S. W. of the town, crowded with instructive fossils. The quarries at Whitcliff for the upper series, and Vinnal Hill for the lower, will afford the collector a fine series of instructive forms.

Through these we passed Burrington, where, in Wenlock shale, great numbers of Trilobites (*Calymene tuberculosa*, and *Phacops caudatus*,) may be met with, enclosed in hard nodules. Unfortunately, they are not easy to split open, without damaging the fossils contained.

Near the Bridge, *Phacops longicaudatus* (which may be only the perfect *P. caudatus*) is plentiful. For this, and other courteous directions, I am indebted to Mr. Marston, of Ludlow, who has devoted so much time to the district. Taking the lane for Whitton, a Lower Ludlow quarry on the right hand gave me some fairly-preserved remains of *Ceratiocaris*, with bifid tail; these spines, generally found separate from the jointed plates, have been variously regarded as ichthyic fin-spines, and crustacean pincers (*Leptocheles*).

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* This bed, lying beneath the upper tilestone, there exposed, has been recently broken into on the crown of the hill. No fossils of importance have yet occurred.

Beyond the quarry, a lane diverges on the right to the famous "star-fish" quarry of Church Hill. Lower Ludlow shales are well exposed along its course; here may be found *Graptolites* in great perfection, and some rare *Orthocerata* (*O. subdulce, O. gregarium*), &c.

Little is now to be got in the star-fish bed; for the thin layer, in which the *Asteriadæ* occur, is kept in place by some 10 feet of solid rock; while the débris of the quarry has been carefully picked over by the Ludlow geologists. However, the collector may obtain from Meredith, a keeper on the Leintwardine fishery, good specimens at a moderate cost. To him geologists are indebted for the discovery of these remarkable fossils. *Palæocoma Marstoni* is at once the commonest and most interesting species. Other forms occur, but more rarely.

Fragments of *Pterygotus*, and limbs and patches of skin belonging to *P. punctatus*, are not uncommon in the upper shales, with *Cornulites* of remarkable but badly-preserved character, and other interesting fossils. A curious branched Graptolite has been recently met with near this place; but I could not learn the precise locality. Meredith has good specimens of it for sale.

The geologist who is returning from this point to Ludlow, should take the path through the beautiful walks of Downton Castle. In some overhanging cliffs a clear section may be obtained, exhibiting Upper Ludlow rock as a cap, covering up Aymestry limestone (with *Pentamerus Knightii*), and Lower Ludlow Beds. The botanist, too, will be charmed to find in profusion *Polypodium dryopteris*, *Cystopteris fragilis*, and *C. angustata*, trailing their exquisitely beautiful fronds down the banks.

I continued my excursion to the Black Mountains, through Presteign and Kington; crossing a country 2,000 feet below the surface-level in carboniferous days, as is witnessed by the detached fragments horizontally stratified, and capped with mountain limestone, which form the lofty Scyrrid, Blorenge, Fans of Brecon, and other spurs of the South Wales coal-field.

The Upper Old Red (Quartzose conglomerate), which forms the great mass of these hills, is singularly unproductive of fossils; but there is a charm in working out the grand development of its physical geology, that makes up for its lack of life-remains. A pleasant and instructive companion to this district is the "Old Stones," of my friend the Rev. W. S. Symonds, of Pendock. Its geology and natural scenery has found in him a truthful and eloquent interpreter. My notes for these mountains must form the subject of another paper.

PRACTICAL GEOLOGY.

ON THE PRACTICAL APPLICATION OF GEOLOGY TO CERTAIN DEPARTMENTS OF RAILWAY-ENGINEERING, WITH A DESCRIPTION OF A METHOD OF MAKING WORKING-MODELS.

By T. E. Curley, C.E., F.G.S., A. Ins. C.E.

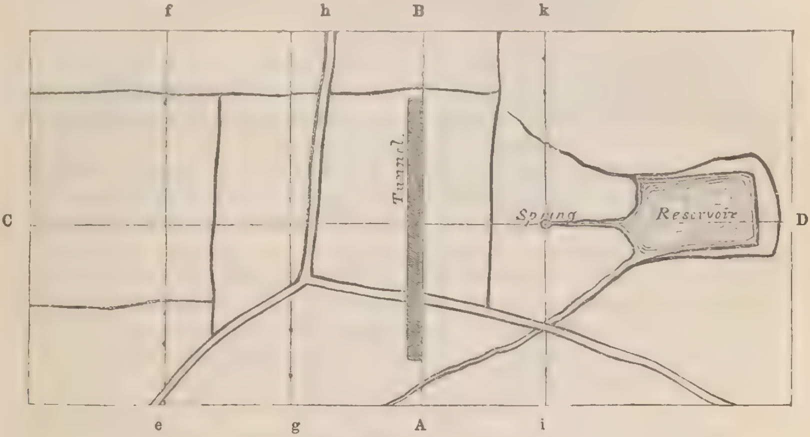
Sir,—Although the following is not purely geological, perhaps you will not consider it inadmissible in your journal, as it tends to illustrate a system of making geological models and sections of large tracts of country for engineering-purposes.

It is a well-known fact that hundreds of thousands of pounds might have been saved in the construction of our railways, if time had been taken to study in detail the geology of the country traversed, instead, as was the case in 1844 and 45, of laying down the projected lines on the ordnance map from the nearest turnpike-road, when travelling at the rate of eight or ten miles an hour, or even, as was very often done, in the office, without seeing the ground at all. Innumerable slips, wet cuttings, wet tunnels, &c., might have been avoided by a slight diversion, based on geological knowledge. For instance, take a line running along a narrow gorge of some small river or stream in a northerly direction, and suppose the rocks on each side to have the same dip from west to east. Now, if the railway be made on the west side, in side-cutting it is obvious there will be slips, if the angle of inclination of the strata is greater than the angle of repose; and certain that the cutting will be a wet one, requiring a flat slope, and involving expensive drainage; whereas, if the railway was projected on the opposite or east side of the gorge, it is highly probable that the cutting would be perfectly dry, and that the slope would stand nearly perpendicular.

In 1843, the Leeds and Thirsk Railway Company projected a tunnel through the Bramhope Hills, from which issue the springs and streams that partly supply the Eccup Reservoir, belonging to the Leeds Water Works Company. In 1845, Mr. Seather, of Leeds, the engineer for that company, instructed me to make a model of the portion of country lying between Eccup Reservoir and Otley, for the purpose of illustrating the geological and engineering evidence required in opposing the railway-bill before the Committees of both Houses of Parliament; and by which we succeeded in getting a clause introduced for compensating the Water Company for any loss of water they should sustain through the railway-works.

The following is the plan I adopted in making the model, which embraced about twenty square-miles of country. In the first place, I made a ground-plan showing the principal roads, streams, springs, &c.; I next took cross sections of the range of hills, twenty chains apart, and parallel to each other; also, a longitudinal section through the centre, at right angles to the line of strike of the rocks, as well as to the cross sections.

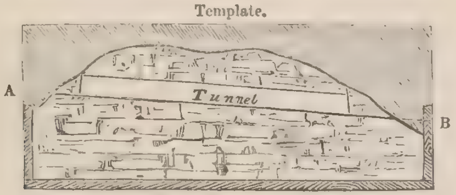
Having obtained these data by means of the theodolite, level, and chain, the plan was plotted and transferred to a board, which formed the base of the model; this board had upright sides and ends, of uniform height, nailed on to it, something like a drawer.



Lign. I. Plan.

A B, Cross Section. C D, Longitudinal Section. e, f, g, h, i, k, Cross Sections.

After the sections were plotted to the proper scale, they were transferred to sheets of tin and cut out, the counterpart of the section forming a template; by leaving a notch each side to rest on the upright sides, this template would be used after the manner of a plasterer's mould; an inspection of the section A B will make this plain. The surface, by means of these templates, was made exact at each line of cross section, and by means of occasional levels, and from memory, the portions between were filled in. The tunnel portion was cut out in wood, and removeable, for the purpose of showing the position of the tunnel, as shown in section A B.



Lign. 2., Cross Section on A B.

In taking the longitudinal section from C to D, the outcrop of the strata was carefully marked, its dip ascertained with a clinometer, and it was afterwards carefully plotted on the section, as shown in the sketch C D. Now, it is plain, from a mere inspection of the longitudinal section C D, that the rain falling on the country between H and K will percolate through the soil and fissures of the rocks until it meets an impervious bed, along which it will run, and issue at the outcrop as a spring, as shown in the cut. This bed being cut through by the railway-works, the water was intercepted and carried into the tunnel, drying up the spring; a prediction that was verified by the fact. I have been informed that the pumping of the water alone, out of the tunnel, during the construction of the works, cost the contractor nearly as much as all the other works relating thereto put together.

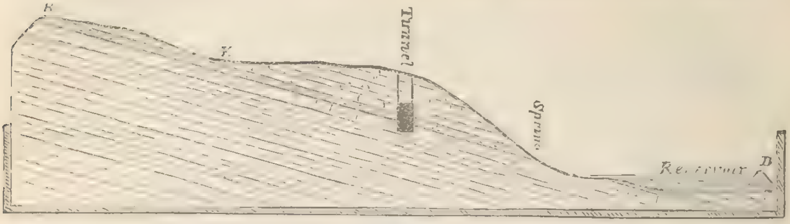


Fig. 3., Longitudinal Section on C D.

ABSTRACT FROM MM. VON HAUER'S AND HORNES' REPORT CONCERNING THE ERECTION OF THE MONUMENTAL BLOCK IN COMMEMORATION OF LEOPOLD VON BUCH.

Communicated by Count Marshall, of Vienna.

It will be remembered that, on the motion made by M. E. Ehrlich, Keeper of the Provincial Museum at Linz (September 20th, 1856), the section for Mineralogy, Geology, and Palæontology of the Congress of German Naturalists and Physicians, then meeting at Vienna, resolved by unanimous acclamation, that an erratic block of granite, situated near Losenstein, between Steyer and Weyen (upper Austria) should be converted into a monument commemorative of the illustrious geologist, Leopold von Buch. In consequence of this resolution, MM. von Hauer and Hornes formed, with M. Ehrlich, an executive committee, opened a subscription with a maximum amount of five florins (about ten shillings) and took every measure to ensure the success of the enterprise by enlisting contributions at home and abroad. The success proved to be beyond expectation. H.S.H. Archduke Stephan and the illustrious Baron de Humboldt expressed their assent in the most flattering terms; Baron Scheucheustael, at the head of the mining department in Austria, and Baron Beust, occupying the same official station in the kingdom of Saxony, have been most active in promoting the subscription within their spheres.

As soon as Sir Roderick I. Murchison had received notice of the project by a letter from Director Haidinger, he answered that, if the amount of the subscription should prove insufficient for the intended monument, he himself was ready to fill up the deficit from his own funds. The French Geological Society proved not less active in promoting the aims of the Executive Committee. The number of the subscribers is 821, and the amount 1,405 florins (about £140 10s.) which have sufficed to pay the expenses (including purchase of land, accessory work, and secondary expenses). Owing to M. Ehrlich's indefatigable exertions, and the co-operation of several notable persons of the neighbourhood, the monument was completely finished during the summer of 1857.

The monumental block, sixteen feet high and 155 feet in circumference at its basis, has a pyramidal form. It lies at the mouth of a valley called "Böchgrabon," on the flattened top of a gently sloping hill. The side facing the valley has been cut into a plane, polished, and provided with an inscription in Latin uncials, engraved one inch deep, and lined with black colour. The letters of the name are one foot high, and are gilt. The German inscription is thus translated:—

"DEVOTED
TO THE MEMORY OF
LEOPOLD VON BUCH,
IN CONSEQUENCE OF THE RESOLUTION
ADOPTED SEPTEMBER 20TH, 1856,
BY THE XXII MEETING OF GERMAN NATURALISTS
AND PHYSICIANS AT VIENNA,
WITH THE CO-OPERATION OF NUMEROUS FRIENDS
OF THE NATURAL SCIENCES
IN GERMANY, BELGIUM, FRANCE, ENGLAND, AND ITALY."

Beneath this inscription are engraved the Miner's emblems: two hammers lying across each other.

At the right of the monument stands a young and vigorous oak; young fir-trees have rooted themselves behind the block and on its eastern declivity; before the monument stands a clump of Rhododendrons. Other blocks, of less dimensions, and the larger fragments resulting from the adaptation of the main block to its present destination, are scattered around it for ornamental purposes, or have been converted into resting places. The access has been made easy by walks, plantations have been made all around, and the whole is closed by a hedge of hawthorn and other indigenous shrubs. The locality where the monument is placed offers not only most picturesque scenery and prospects of uncommon beauty, but it is also highly interesting on account of its remarkable and diversified geological structure; and the proximity of the magnificent Abbey of Kremsmünstere, and the neighbourhood of important mining and metallurgical establishments.

CATALOGUE OF THE GOVERNMENT SURVEY MAPS AND SECTIONS.

The following list cannot fail to be of utility to every practical geologist as a table of reference, and its usefulness will be felt by others, who are, perhaps, in ignorance, as many undoubtedly are, of even the existence of these valuable geological maps and sections.

The reason of such ignorance is, probably, that Her Majesty's Government do not allow usual trade-commission to the booksellers, who will not, therefore, obtain them, except for such good customers as they cannot refuse, as these publications bring to them no profit, and often incur actual expense.

Provincial geologists, moreover, find it no easy matter to ascertain what portions of the country have been examined, and plotted, and coloured upon the ordnance maps, by the Government officers, and it is still more difficult to obtain information of the sections, and of the "decades" of fossils.

The publications enumerated below are not only of geological, but of great national value, and it is therefore very desirable to make known to our readers that they can be obtained in London, of Mr. Stanford, mapseller and publisher, Charing Cross: of Messrs. Longman, the Government publishers, Paternoster Row; and of Messrs. Letts and Son, Royal Exchange.

By the courtesy of Mr. Stanford we are enabled to append to this paper a reduced index map of the divisional portions of the survey, which will greatly facilitate the object of this catalogue.

THE GEOLOGICAL MAP AND SECTIONS OF ENGLAND AND WALES.

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(*To be continued.*)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Daubree's researches on recently-formed Minerals—Action of Mineral Waters upon old Roman Cement—Daily production of Zeolites, Fluor-Spar, Arragonite, &c.—Plombierite—Time an important element in Geological Experiments—Delesse on the Metamorphism of Argillaceous and Siliceous Rocks—Earthquakes at the Cape of Good Hope—Apparition of different kinds of Fish after violent Earthquakes.

Professor Daubrée, of Strasburg, has obliged us with a copy of his interesting "Memoir on the Mineral Deposits of the Thermal Springs of Plombières." We hasten to make known to our readers the important results contained in this new work.

The investigations already made concerning the natural beds of those minerals, which have been classed in the family of Zeolites,* have led mineralogists to believe that water has been active in their formation. We have already shown † how M. Daubrée has reproduced in his laboratory a certain number of Silicates, and how he discovered that they had been formed in certain springs at Plombières since the time of the Romans. The present Memoir completes our knowledge of these interesting phenomena—and what can be more interesting than the formation of a stone before our eyes! It appears, moreover, that Zeolites have rarely or ever been artificially produced, and their origin has always been more or less enveloped in mystery.

In order to augment the volume of water in the warm springs of Plombières, the author has been constructing a deep aquaduct, for which it was necessary to cut through a crust of cement which the Romans formerly spread over the valley where the springs rise. This cement is composed of fragments of bricks, variegated sandstone, and lime. It has been powerfully acted upon by the mineral waters which come in contact with it at a temperature ranging from 50 to 60 degrees (centigrade). The lime and the bricks themselves have been thus transformed into new combinations, which have crystallised in their cavities. Among the products of this transformation, the most frequent are certain Zeolites, and especially *Chabasite* and *Apophyllite*. The former, which is a silicate of alumina and lime, is generally found in the spilites of certain basalt formations, in the Tyrol, Bohemia, the Hebrides, &c.; the latter, a silicate of lime and potash, is seen also in the cavities of spilite rocks and in the beds of magnetic ironstone in Norway, Sweden, &c. The samples taken from the warm springs of Plombières were in perfect, well-defined crystals, and in every respect similar to the minerals from the above-named countries.

Besides these, many other Zeolites are formed at Plombières, but their exact species has not yet been accurately ascertained. M. Daubrée names, therefore, with uncertainty *Scolezite*, *Harmotome*, and *Gismondine*. He mentions, also, the presence of a probably new species of hydrated carbonate of magnesia, which crystallizes in rhomboid laminæ of a pearly lustre.

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* Hydrated Silicates, partly soluble in strong acids.—T. L. P.

† *Vide* the Geologist for Feb., 1858.

The cavities of the Roman masonry contain *Hyalite* and other varieties of *Opal*. *Arragonite* is also found in these cavities; the samples are bipyramidal crystals, very acute, resembling those found in the iron-beds of Framont and certain basalt formations. *Calcareous-spar* is seen mixed with the crystals of Chabasite before mentioned, and in the same cavities are observed small crystals of *Fluor-spar*, which have, in some places, their usual and beautiful violet tints. We must add that Professor Nickles, of Nancy, has very recently discovered fluorine in the mineral waters of Plombières. Does the presence of this fluorine (contained in the water in shape of fluorides) explain that of Daubrée's crystals of fluor-spar, or do the latter account for the discovery made by Nickles? There can be hardly any doubt that it is the presence of certain fluorides in the waters of Plombières that has given rise to the formation of the Blue-John or fluor-spar seen by M. Daubrée,* by their action upon the lime of the Roman cement.

In certain cavities and fissures where the Roman cement is exposed to a direct stream of warm water, a gelatinous substance is precipitated, which, by contact with the air, hardens, becomes quite opaque, and as white as snow. This substance analysed by M. Daubrée, turns out to be a new mineral, a silicate of lime, to which he attributes the composition

$$\mathrm{CaO\ Si\ O^2 + 2\ HO}$$

Silicate of lime + water.

He calls it *Plombierite.*

In spite of the extreme hardness of the Roman masonry, it gives, nevertheless, access to the mineral water, which not only penetrates it in all directions, but actually passes through it. This passage is very slow, but continuous, and permits the chemical reactions which take place to multiply slowly for an immense space of time—an experimental element which modern chemists are in the habit of neglecting, but which the old alchymists knew well how to take into consideration.† That time plays an important part in those essays by which we endeavour to imitate natural productions, is seen by those beautiful experiments of M. Daubrée's, to which we have before referred, and in which *one month* was not deemed too long a period for *one experiment*. The mineral water of Plombières acts upon the masonry by the alkaline silicates it contains, and forms Zeolites in abundance. These crystallize at a temperature which is inferior to 60 degs. (centigrade), consequently under the simple pressure of the atmosphere, and almost at the surface of the soil. The crystals of Chabasite are always found in the bricks, the Apophyllite exclusively in the lime, which circumstance is in perfect accordance with the natural composition of each, and shows that their elements have not been totally brought by the water, but partly furnished by the cement. Hence the conclusion, that "the same dissolution, acting upon masses of different nature, developes in each distinct combinations," arrived at by M. Daubrée. This geological formation, which at Plombières is taking place under our eyes to a certain limited extent, has doubtless been accomplished in bygone ages to an immense extent. It is evident that many eruptive rocks must have been penetrated by water during the period of their cooling, and on a far larger scale, at a higher temperature, and under a much greater pressure than at the miniature laboratory, which Nature seems to have opened for the benefit of her pupils, at Plombières.

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* M. Jutier has just discovered at Plombières a large vein of Fluor-spar in the granite, which is traversed by the mineral waters, and whence doubtless these waters derive their soluble fluorides, which coming in contact with the lime of the masonry are transformed anew into fluor-spar.—T. L. P.

† Hortulanus, in the sixteenth century, says that to procure the Philosopher's Stone, "On fait digérer pendant douze jours des suer de mercuriale, de pourpier," &c. The celebrated alchymist Geber says, "I have seen mines of copper from which particles of this metal were carried away by a current of water. This water having dried up, the atoms of copper remained three years in the dry sand. I discovered that at the end of this time they had been cooked and digested by the heat of the sun and changed into laminæ of pure gold. By imitating nature we produce the same transformation." Hoeffer, in his "History of Chemistry," say that experiments begun by certain alchymists of the middle ages were often transmitted from father to son as an inheritance; and that the son, not having lived long enough to terminate them, left them by will to his children.—T. L. P.

We have collected together the most important facts contained in M. Delesse's new Memoir on Metamorphism, for the purpose of relating them here, as it will be seen, if we mistake not, in the following lines, to what an extent water seems to have been active in the metamorphic transformations so perseveringly studied by this geologist. We have already mentioned the latter author's observations on the metamorphism of *carboniferous rocks* of every description, and also the results of his researches on the transformations of *limestone rocks and strata*, under the influence of eruptive or plutonic rocks.* In the work of which we speak here, *argillaceous* and *sandstone rocks* are studied from the same point of view. The latter, under the modifying influence of eruptive trap-basalt, dolerite, &c., present many phenomena well worthy of being recorded. Let us consider, first, the siliceous rocks:—

We find that their metamorphism, like that of limestone, is characterised either by the formation of certain minerals, or by peculiar modifications in their structure. Amongst the minerals thus formed are hydrated oxides of iron and of manganese, and certain carbonates, principally carbonate of lime, dolomite, also carbonates of magnesia and iron, sometimes silica. Among hydrosilicates ferruginous clay, and especially Zeolites, are formed. Green-earth is seen penetrating sandstones, to which it gives its colour, but their quartz remains as transparent as before, and comparatively unchanged. This metamorphism has been particularly favourable to the formation of Zeolites, which are seen to have been thus formed in the most compact of sandstones, and are even met with in common flint.† In most cases the Zeolites form a sort of white cement, filling up the small cavities between the grains of quartz in different sandstones. At other times they are seen as microscopic nodules, and often in perfect crystals, lining the cavities of the siliceous rocks.

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* The GEOLOGIST for February and June, 1858.

† Flint is undoubtedly of aqueous origin.—T. L. P.

The structure of the latter is observed to have become prismatic, lithoid, cellular, vitreous, or even marbled. When a sandstone has been thus modified, it has lost its red colour, which is replaced by white, grey, green, or black tints; the rock has become sonorous, and, under the hammer, breaks into splinters. When of a friable nature, the grains of quartz in the siliceous rocks have been cemented together by metamorphism, and even in the sandstones which present the most compact appearance the arenaceous structure is easily rendered evident by the action of an acid. When a prismatic structure has been taken by sandstones, the prisms are well-defined and perpendicular to the surface of contact with the trap-rock; their section is small, but their length attains sometimes as much as two yards and more. Sandstone which has become prismatic by the contact of basalt, contains a certain quantity of water, and when the former rock has taken a vitreous or cellular structure at the same time, it has undergone violent metamorphism, but still contains water, and its density has been diminished.

"The metamorphism experienced by argillaceous rocks from contact with traps," says M. Delesse, "is very difficult to define, as the former contain almost all the elements that are found in the eruptive rock that has modified them. The proportions of these elements, then, alone can vary, hence chemical analysis can only show us the modifications these proportions have undergone. Moreover, as these rocks are very compact, minerals can only be formed in their cavities and fissures; and it is easy to see that the latter do not differ from those formed in limestones and siliceous rocks under the same influence."

The structure of argillaceous rocks, however, has undergone, by metamorphism, very great transformation, in a thousand different ways. An argillaceous rock may, however, sometimes be seen in immediate contact with traps, without having undergone the slightest change. On the other hand, the structure of the former is often observed to have become polyhedral, pseudo-regular, spheroidal, or even prismatic—the prisms being formed of hard clay, which has shrunk, but which contains as much water as the original unaltered clay. Generally speaking, argillaceous rocks that have been modified by upheaving traps, &c., have become hard and lithoid, or stony, and have lost their water and the carbonates they contained originally. By contact with trap-rocks in which zeolites are abundant these clay strata have often been changed to *Pelagonite*, being penetrated at the same time by different species of zeolites, carbonate of lime, silica, and the minerals peculiar to the Amygdaloidal rocks. They have likewise become cellular and transformed into spilite, especially if they be calcareous, in which case they lose, by metamorphism, the greater part of their carbonates. In these cavities are seen, also, the minerals peculiar to Amygdaloids.

Argillaceous rocks have often been changed into *jasper* by the metamorphic action of certain traps. In this case they preserve, more or less, the marks of their original stratification, which are represented by parallel bands or veins. They have thus become hard, compact, and of bright and varied colours.

Porcelanite-jasper is observed in contact with basalt-rocks, its characters denote that it bears a great resemblance to Pelagonite. The metamorphism of argillaceous rocks into jasper is very frequent, and must not be regarded as a *silicatization*, for analysis shows that the jasper thus produced contains, in most cases, less silica than the rock from which it has been formed The presence of alkalies in an argillaceous rock seems to have facilitated its metamorphic transformation. Hence *argilolite* has been more easily transformed than *clay*.

The minerals formed by metamorphism, added to the changes produced by artificial heat on clay rocks, show that during metamorphic action the temperature was tolerably moderate, and that water must have played as great a part as the contact of the eruptive rock.

We promised, in our last paper, to refer again to M. Castelnau's observations on the earthquakes of the Cape of Good Hope.

On the 14th of August, 1857, at half-past eleven at night, Cape-town experienced a violent shock, which was followed by two others of ten seconds' duration each. The whole phenomenon lasted about forty minutes, or rather longer, especially near the Table Mountain. The usual subterranean thunder was heard at the same time. Domestic animals appeared as frightened as the men.* Luckily, at the Observatory none of the instruments were disturbed.

This earthquake was felt 200 miles to the north, and 400 miles to the east of the Cape. The direction of the undulations seems to have been that of the meridian. The ships stationed in Table-bay all felt the effects of the shock, and the "Solertia," a vessel commanded by Captain Boisse, which, at the time of the earthquake, was one hundred miles south of Cape-point, was launched out of its course to the eastward.

The same observer informs us that these phenomena have been comparatively rare at the Cape of Good Hope. Since the commencement of the present century, we have only the following on record:—In the year 1809, a succession of shocks lasted from the 4th of December to the 24th of the same month. In 1811, an earthquake, felt on the 2nd of June, was described by Burchell, who says that a shock was also experienced in the preceding year. In 1843 a very slight motion of the earth's crust was observed. The most formidable of these, and perhaps the worst that the Cape ever experienced, was that of the 4th December, 1809. Among the curious effects produced by it, we will mention the following:—In Table-bay is now seen a fish belonging to the genus *Gadus*, and probably identical with that which Linnæus named *Merlucius*. It seems satisfactorily proved that the appearance of this species at the Cape immediately followed the formidable earthquake of which we speak; it was never seen or heard of in these latitudes before the 4th of December, 1809. Dr. Andrew Smith, in his *Illustrations of the Zoology of South Africa*, speaks of a similarly curious coincidence as regards another fish—the *King's Fish* (*Xiphiurus Capensis*), which, according to this author, "appeared in the precincts of the Cape after an earthquake; it is not mentioned which, but at all events it must have been a considerable time back, as the traveller, Barrow speaks of the *King's Fish* as being found near the Cape in 1797."

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* See The Geologist for July, 1858, p. 300. In reference to Boussingault's observations, recorded in this number, we will quote here Alexander von Humboldt's words on the same subject:—"To man," says this illustrious author, "the earthquake conveys an idea of some universal and unlimited danger . . . . We are accustomed from early childhood to draw a contrast between the mobility of water and the immobility of the soil on which we tread; and this feeling is confirmed by the evidence of the senses. When, therefore, we suddenly feel the ground move beneath us, a mysterious and natural force, with which we are previously unacquainted, is revealed to us as an active disturbance of stability. A moment destroys the illusion of a whole life; our deceptive faith in the repose of nature vanishes, and we feel transported, as it were, into a realm of unknown destructive forces. Every sound, the faintest motion in the air, arrests our attention, and we no longer trust the ground on which we stand. Animals, and especially dogs and swine, participate in the same anxious disquietude; and even the crocodiles of the Orinoco, which at other times are as dumb as our little lizards, leave the trembling bed of the river, and run with loud cries into the adjacent forests."—T. L. P.

We read in an old Spanish proverb, that "things which are very singular are apt to become wonderful." But here are instances of like phenomena from another source:—At the destruction of Riobamba, in the year 1797, recorded by Humboldt, when the shocks were not attended by any outbreak of the neighbouring volcanos, "a singular mass called *Moya*," he says, "was uplifted from the earth in numerous continous, conical elevations; the whole being composed of carbon, crystals of Augite, and the siliceous shells of Infusoria." The same celebrated writer, speaking of the volcanos of the Andes, says, "Cavities, which are either on the declivity or at the foot of the mountain, are gradually converted into subterranean reservoirs of water, which communicate by numerous openings with mountain springs, as we see exemplified in the highlands of Quito. The fishes of these rivulets multiply, especially in the obscurity of the hollows; and when the shocks of earthquakes, which precede all eruptions in the Andes, have violently shaken the whole mass of the volcano, these subterranean caverns are suddenly opened, and water, fishes, and tuffaceous mud are all ejected together. It is through this singular phenomenon that the inhabitants of the highlands of Quito became acquainted with the existence of the little Cyclopic fishes (*Pimelodes Cyclopum*) termed by them prenadilla."

It has not yet been well ascertained whence come the numerous dead insects that Palmieri has often spoken of as filling up the mouths of *fumerolla* on Vesuvius, about the month of May or June, and which were observed again, as usual, last year.

NOTES AND QUERIES.

STATEMENT RESPECTING A FROG FOUND IN SOLID FREESTONE, 90 YARDS UNDER GROUND, AT DUNDONALD COLLIERY, IN FIFE.

In the year 1856, two miners of the names of Henry Allen and David Mitchell, were employed by Mr. Nasmyth, the lessee of the Dundonald Coal-field, in working a seam of coal called the "Little Splint," about 45 fathoms from the surface. Between that seam and the surface are various seams of coal, freestone, shale, ironstone, and other usual strata. Some of these seams of coal have been worked in former times, and, of course, as these workings were abandoned for other parts of the mine, the old workings would get flooded, or, in mining-language, drowned. The strata other than the coal-seams are unworked, and, of course, exist in all their solidity at the present moment, one of them being a seam of ironstone not considered sufficiently valuable to be worked at present. Below the "Little Spint" coal-seam, on which the miners were employed, is a stratum of solid freestone rock, 7 fathoms or 42 feet in thickness, and below that other coal-seams are known to exist, but these have not yet been worked, nor fully explored.

The "Little Splint" coal is not a thick seam, and, as it was being worked, it was thought advisable to give more room for the haulage of the coal by taking up a few feet of the freestone rock which lay below it. The miners above-mentioned were specially employed in this labour, and in blasting it to the required depth. In this latter operation, it is necessary to be careful in seeing whether there are any rents, fissures, or cracks — technically called "cutters" — of any kind in the rock, because, if there are, the powder will not have effect, and the miner's labour is lost. In this instance the miners state that the rock was peculiarly solid, and free from anything of the sort, being, in fact, as they termed it, a fine rock to blast. On one occasion they bored, as usual, the holes on the top of the rock to the accustomed depth; having previously examined the solidity of the part where these were to be drilled, they put in the powder in the usual manner and fired it, retiring, of course, out of danger. As soon as the explosion had taken place, the miners went forward to take away the pieces which had been blown apart, when an animal jumped out of the rent which had been made by the explosion. It jumped a considerable distance, apparently with a strong convulsive effort, and then jumped again in another direction, and continued doing so three or four times in succession. Henry Allen was much alarmed at the apparition, and ran away to call Charles Nasmyth, the overman of the underground workers, who immediately ran to the spot, fearing some accident had happened. On his arrival (only a few minutes afterwards) he found Mitchell examining the animal, which proved to be a frog, and which by that time was almost dead, or at least was just expiring. A can of water, which the miners had for drinking, was there at the time, into this they put the frog; they then examined the place whence it had jumped out, and discovered a cavity just below where they had made the selection for placing the boring tools; this cavity was ten inches long and about three inches or so in width and depth, while the rock was perfectly solid all round it. It was horizontal, as shown in the accompanying sketch. There was no water in it, but it was slimy, apparently from the frog itself. There was a good deal of blackness about it as well as about the frog; but that appeared attributable to the powder, as the frog afterwards became lighter in colour. Mr. Nasmyth, the lessee of the colliery, took the frog to Kirkaldy, where it was exhibited for some time, and, then hearing that I was making a collection of fossils found in the various coal-mines belonging to me, gave it to me, and it is now in my possession.

The above are the facts of the case as detailed to me by Henry Allen and Charles Nasmyth themselves, who are still at Dundonald Colliery, and whom I went expressly to question on the subject. I asked why they did not bring up the pieces of the rock; they said they did not think of it, as it was their business to output coal and not stone, and, thinking it an established fact, that animals had been found living surrounded by a solid mass, they did not think so much of the affair as to induce them to take that trouble. Had they believed that geologists and scientific men, to free themselves from the trouble of attempting to account for the phenomenon, or from disinclination to abandon ideas and prejudices which exist in their minds, would prefer to deny the truth of the discovery entirely, they would have taken pains to have had the place well examined by practised observers—for the stones and everything connected with the circumstance were perfectly accessible, and were visited by all who chose for several weeks afterwards.

Scientific men, who have been referred to, seem to have great difficulty in this case. The facts so completely militate against all the theories of science in general, that rather than attempt to account for this or take any trouble to inquire further into the matter, they prefer to denounce the whole as a fabrication, and the discoverers impostors. Of course, such a conclusion as that would settle the whole affair most satisfactorily to their own minds; but to those who, like myself, are willing to believe in the veracity of the discoverers, some other solution is necessary; and I confess I see less difficulty in considering the frog as co-eval with the freestone than in crediting the existence of "backs and cutters," or air holes and fissures of such a nature as to have allowed the said animal to have got into the cavity lately, because it is necessary to fix some probable or possible data for its finding its way to the place. Besides, the very fact of spawn (did such a "cutter" exist right through every seam of coal, ironstone, freestone, &c.) not finding a crevice or cavity of some sort or another till a depth of ninety yards, in which the frog could be generated, appears to me to be far more improbable or impossible than the facts which geologists condemn as absurd.

I shall be glad if the scientific world in general would take up the consideration of this subject, and investigate into the case for themselves. I shall be happy to give or to obtain any further information that may be directed to yours, &c.,

R. B. WARDLAW RAMSAY, Whitehill.

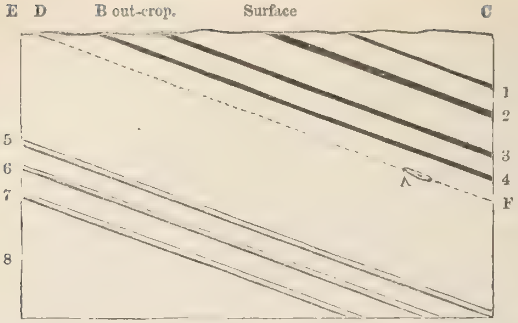
We have printed in full the above clearly-written account of Mr. R. B. W. Ramsay's miners, respecting the living frog found in the Dundonald Colliery, because it is a more definite notice of such a circumstance than has been usually given.

Notwithstanding the natural improbability, not to say impossibility, of an animated being existing for myriads of years, without food or air, inclosed in solid stone, we constantly hear of frogs being so broken out of rocks free from cracks and fissures, and as constantly, under the idea that these frogs must be co-eval with the stone, we have in each case the circumstance tauntingly put to geologists as an insurmountable difficulty to deal with.

All the frogs hitherto so found inclosed in rocks, without any exception, have belonged to existing species, and of species living, too, at the surface in the very district of the supposed discovery. Now, the batrachian reptiles of the coal-measures belong to that peculiar class styled labyrinthodonts; and, as no existing reptiles are, by all the evidences of geology, of older date, at most, than the later Tertiaries, it follows that unless the so-called inclosed animals possess labyrinthodont characters, they must be of recent birth.

The whole question of whether frogs can exist inclosed in solid substances and deprived of air, has been thoroughly gone into by Geologists. The late Dr. Buckland proved beyond doubt that frogs would not exist for any considerable time inclosed in blocks of stone; but in his experiments, (see *Geol. Journ.*, Vol. V., p. 313. *Ed. New Phil Journ.*, Vol. XIII., p. 26. *Silliman's American Journal*, Vol. II, p. 272. *Isis*, 1834, Vol. X., p. 988,) it was evident that air was necessary for the frog's existence. They would live for some time inclosed in cells of porous materials, but in impervious cells they invariably died.

The distinction, however, of extinct or recent form is quite sufficient for the settlement of the point; and therefore where evidence is given, as in the instance above, of a fact, we have only to see if it can be reasonably accounted for, without attempting at all to invalidate the evidence, which, in the generality of these cases, we believe to be faithfully recorded up to a certain point of investigation.



A. Hole containing the frog. **B.** to **C.** Extent of surface shown in Mr. Ramsay's sketch. **B.** to **E.** Continuation of surface to show outcrop of "parting" represented by the added dotted line D. F.

1. Little splint coal. 2. Rough coal; several beds of coal, shale, freestone intervening; also a seam of ironstone. 3. Main coal, with freestone rock intervening. 4. Little splint coal, under which freestone pavement, in which the hole A occurred. This hole was 10 inches long, by about 3 inches wide. 5, 6, 7, 8. Seams of coal and various other strata below the freestone in which the frog was found. Distances—height from A to surface C B 90 yards. From A to D about 400 yards. From A to the coal-seam No. 4 about 2 feet.

In the diagram given above, which has been faithfully reduced from the original sketch forwarded to us, we have dded the dotted line D. F. Now, we accept the statement of Mr. Ramsay that there were no fissures or "cutters" of a vertical character; but we know that forty-two feet of rock could not exist without many intervening planes of bedding; and looking at the lengthened form of the cavity, it appeared to us, at the first glance, to lie in one of the planes of bedding, and on drawing the dotted line D. F. this becomes prominently evident. This line of bedding will outcrop beyond B. at the surface, at a point we will call D. Now, springs and the water of rain-falls constantly percolate along these lines of bedding; and, although it would be very difficult to get frog-spawn down vertically into such a cavity as A, it would be very easy to do so along the line of bedding D. F., and it seems to us that this is the easiest and most natural explanation. At all events, if this be not the right explanation, the frog was a recent one; and as an animal of recent form cannot be co-eval with the coal-rock, we must still search among natural causes for the solution.

Geology of the North Staffordshire Coal-fields.—"Sir,—For the information of your correspondent in the June number of the Geologist, I beg to inform him that in addition to the coloured maps, the Government Geological Survey has just published two sheets of Horizontal Sections (Nos. 41 and 42), across the North Staffordshire Coal-field, accompanied by short explanatory memoirs, which may be had either with, or without, the sheets of sections.—E. H.

Cuttings on the Nairn and Keith Railway.—The railway between Nairn and Keith, establishing through communication from Inverness to London, has just been completed, and the locomotive, for the first time, has crossed the Spey, and inaugurated a new era in the Highlands. The following description has been taken from the *Inverness Courier*:—"With regard to the district through which the line of railway passes, it is a great improvement upon that lying around the present coach-road. The rise from Elgin is very soft and beautiful, giving a fine idea of the fertility and amenity of Morayshire. The valley of the Spey is also very attractive; the hills are lofty and majestic; the trees well-grown and varied; while such spots as the country-seat of Mr. Wharton Duff, give it that aspect of wealth and comfort which we Highlanders have from the earliest times associated with the "laigh land of Moray." From the Spey upwards to the Gorge of Mulben, the railway passes through a defile in which a wild Highland burn winds from side to side, crossing repeatedly underneath the railway, and hence occasioning very heavy works. In one place the bed of the stream had to be causewayed with large stones for a considerable distance. The rock has had to be deeply cut in several parts, and the cuttings exhibit beautiful sections of quartz-rock and mica-schist, disposed in such regular and thin strata, dipping from north-east to south-west, as to suggest the idea that the whole are only altered Silurian rocks, hardened by internal heat. The inequalities scooped out by ancient currents among the rocks have subsequently been filled with a very hard deposit of clay and gravel, forming what is called northern drift or till, so very hard as, sometimes, to be mistaken for conglomerate-rock; and indeed, in one spot, for a few hundred yards, this deposit was contracted for to be removed as solid rock, which it was believed would have occasioned a tunnel in the line of the railway. Under the pickaxe, however, the whole gave way gradually, and no rock *in situ* was met with at the point in question. Cliffs of the boulder-clay and gravel overhang the railway, sometimes disposed in grassy terraces, and sometimes covered with beautiful clumps of birch, oak, and ash trees; and these cliffs, a little way below the viaduct across the Spey, extend down the river's side in high, naked precipices, exhibiting one of the deepest and most extraordinary series of clay and gravel beds to be seen in any part of the Highlands."—J. JAMESON.

GEOLOGY OF MUCH WENLOCK.—"SIR,—Can you inform me of any works on the Geology of Much Wenlock and the Brown Clee and Caradoc Hills (Salop), with their prices? also, when you expect to publish the 'Glossary' spoken of in the March number of the GEOLOGIST, page 115? Thanking you for your kind answer to a former query, and Mr. Plant for his valuable information in the last number of your magazine, I remain, your's, &c., M. S., Ashby-de-la-Zouch."—The best work on the Wenlock districts is Sir Roderick I. Murchison's "Silurian System," published in 1839, price £8 8s. Sir Roderick's condensed memoir on the Silurian System was published in 1854, price £1 10s., under the title of "Siluria," a new edition of which book is now passing through the press, and will be improved by many very important additions.

It is our intention to commence the glossary on the completion of Professor Morris' "Stratigraphical Catalogue of British Fossils."

ROMAN MINES IN WALES.—Mr. Thomas Wright, the eminent antiquary, is preparing a work on the Roman mining-districts of North Wales and the border-country, viewing them especially with regard to archæological and historical results. Any information relating to traces of Roman mines, or of ancient workings of any kind, will, we know, be very acceptable to him. Such investigations bring archæology into close connection with geology, and we shall be glad if this notice should elicit any information from our readers to the advantage of Mr. Wright's work. Geological notices of these old iron and gold-works would be interesting to many of our readers.

THE COLLECTING OF RECENT SHELLS.—FOSSILS FROM COAL STRATA.—"SIR,—Will you please tell me in your next number of the GEOLOGIST, how I may get animals out of delicate univalve shells, such as Helix, Lymnæa, &c.? In the roofs of coal-mines, there are many large nodular iron-stones, in which are many shells very like Ammonites, *i.e.*, they are spiral, but much thinner in the middle than at the edges, and when ground down do not show any septa like Ammonites; what are they? When is the best time of the year to collect shells? My work on conchology gives no instruction to beginners, hence these questions; it is Capt. Thos. Brown's Land and Freshwater shells."—S. H., Huddersfield.—As other sciences besides geology are embraced in the study of the earth, we reply to this query respecting living shells, and partly, also, because whenever information respecting recent animals or plants has a tendency to elucidate geological investigations, we shall not deem such questions irrevalent, as they will enable us to make suggestions, of more or less value, in their elucidation. The best instrument for extracting molluscous animals from their shells is an ordinary needle firmly inserted in a penholder or cylindrical stick, and afterwards bent or "hooked" in the flame of a spirit-lamp. The best time of the year to collect shells is in the late autumn, when the annual or periodic addition of shell-matter has been completed and solidified—the new portions in their early stages being gelatinous and brittle. We would ask if any one has observed if the fossil shells in any of our freshwater strata exhibit this difference in thickness and condition between the old and new shell-matter? By this means, where numbers exhibited such peculiarities of growth, we might, sometimes, obtain a knowledge of the *time of year* at which the fossil mollusca died, and their entombment in the deposit took place. Such inferences would prove of value. No English work on recent mollusca is comparable with Forbes and Hanley's "British Mollusca," published by Van Voorst, If this work, however, is too costly, Wood's "Index Testaceologicus" is a very good substitute, and Woodward's "Manual of the Mollusca," published by Weale, is an inexpensive but admirable assistant. full of illustrations, and the matter clear, lucid, and correct. This last work is the best book for the student, and contains at pages 17 and 623 full instructions for collecting. The Ammonite-like shells referred to as occurring in the ironstone-nodules of the coal-measures are probably specimens either of Bellerophon or Goniatites. We could tell by the transmission of specimens or of gutta-percha casts.

Proposition for an Association of Amateur Geologists.—"Sir,—I take the liberty of submitting to your consideration for approval, or otherwise, the suggestion of the advisability of young geologists (*i.e.*, young as regards their progress in the science) forming themselves into a society. If you approve of this suggestion, will you be kind enough to give it publicity in the correspondence columns of your periodical? The best reasons I can adduce in support of this idea are the circumstances of my own case as a solitary student of the science. About four years ago a perusal of Lyells' "Elements" led me to perceive that geology was nothing less than a study of the physical history of the globe, and of the races that have successively inhabited it. Since that time I have studied the other works of Lyell, and also those of Buckland, Mantell, Miller, Page, Ansted, &c. And this amount of theoretical knowledge, with the results of a few rambles in the Thames-basin, and along the sea-coast from Ramsgate to Brighton, is all that I can boast of. I have never been able to meet with a single individual with whom I could exchange a dozen thoughts upon geology. Sometimes, indeed, I have thought that I never should be able to enjoy that pleasure; but the mere fact of the publication of the Geologist is an evident proof that geology is more generally studied than I thought it was. Besides, my circumstances are such as to prevent me, not only from obtaining such works as Murchison's "Siluria;" Agassiz's "Poissons Fossils," &c., but also from taking long journeys, or spending much time in the country. There are also many maps which I should like to study but which I cannot afford to buy. Now, Sir, I doubt not there are many young men in London whose individual cases in many respects resemble mine, and were we to form a society, meeting at stated periods, we could compare notes, give account of our rambles, examine one another's fossils and minerals, exchange duplicates; whilst the subscriptions would purchase maps and books such as individually we could not obtain; and in many ways we could be of great assistance to one another. I throw out the suggestion in a very general manner, this not being the proper occasion for entering more minutely into details; but hoping that the idea itself will meet with your approbation, I am, Sir, yours, W. J. Haywood."—To this proposal for the association of young geologists we are disposed to give our assistance, but we should have liked to have placed something more definite before our readers, and for this purpose we wrote direct to the author of the suggestion. From some informality, or incorrectness in the address, our letter has been returned to us from the post-office. We can, therefore, only express our sympathy in the project, and say that we shall be happy to be the medium of communication until definite arrangements are made by the suggester and others for carrying it out.

Private Collections.—"Dear Sir,—I wish to say, following the example of the Rev. Mr. Brodie and others, that my collection is open to geologists when I am not absent from Richmond. It is a general British one, and particularly rich in carboniferous *Brachiopoda* and *Crinoidea*. Of the latter interesting family, I have been again very successful in discovering another new genus, as well as some further new species. I am about leaving for Belgium, to visit my learned friend, Professor de Koninck, at Liége, and intend to be the bearer of some deeply interesting forms from this district, as well as two perfectly new crinoids just discovered in the greensand of the classical Iguanodon-quarry, at Maidstone, by W. H. Bensted, Esq., and which that gentleman, with the disinterested liberality of all true lovers of science, has placed at our disposal, to examine and describe. On this subject I would wish to promise your readers an early notice.—Yours very truly, Edward Wood, Richmond, Yorkshire."

Private Collection.—Exchange of Fossils.—"Sir,—I was glad to find, in your June number, that you proposed giving illustrations, &c., of all the British Fossils, as such an arrangement will be of advantage, both to myself, like your correspondent Amator Naturæ, as well as more of your readers in this neighbourhood, that I am acquainted with. I have a good collection of fossils out of the mountain-limestone; but, owing to the more expensive books being beyond my reach, I am unable to arrange and classify them accurately. Were these named, having plenty of duplicates, I should be able to exchange, as I see from your advertisements and correspondents gentlemen are willing to do so, for named specimens. I may add that I shall be happy to show my collection to any brother geologist who may call upon yours, &c., Jno. Froggatt, Churchgate, Stockport."

Geology of Hay (South Wales).—Sir,—"Every month I hail with sincere pleasure the arrival of the Geologist, and feel much affection for the sturdy old Mammoth which so appropriately adorns the corner, because he is the harbinger of a variety of new and interesting information which every lover of "the hammer" must be glad to obtain for the reasonable sum of one shilling. Like most enquirers, I am always happy to meet with a good deal of information in a small space, and therefore invariably in the first place digest the matter contained in that pre-eminently useful portion called "Notes and Queries," leaving the separate articles to be conned at leisure. Being a subscriber and an embryo geologist, perhaps I may trouble you with the following queries? 1. What portions of the Old Red Sandstone is it that abounds in this locality, and what fossils (if any) does it contain? 2. Quantities of gravel abound in some of the valleys—a section 20 feet in depth, containing a large stone, probably half a ton or more in weight, being exposed not a quarter of a mile from Hay. Is this a portion of the boulder-drift? 3. In my rambles I frequently meet with a dark brown sandstone filled with casts of minute shells, the two most conspicuous impressions being a small spiral one, about a quarter of a inch in length, and a bivalve, not unlike a Terebratula, only broader, and about half an inch long. The stone is always water-worn, and is found in abundance. I should be greatly obliged if you could say what the impressions are.—I am, Sir, your most obedient servant, Hay, South Wales."—To the south and east of Hay the cornstones, or calcareous middle portion of the Old Red of Herefordshire crops out. In the north-west, the lower portion, consisting of red marl and tilestones, comes out, resting on the Silurian rocks of Radnorshire. The cornstones should be examined for remains of *Cephalaspis*, and the other curious fishes and crustaceans of the Devonian, or Old Red period. The tilestones are likely beds for similar remains, together with *Lingulæ* and some other small shells; also plant-remains, such as have been found near Ludlow. 2. The gravels and boulders near Hay are of local origin, and not a portion of the great "northern drift." They are derived from the Silurian and Trappean rocks of the Radnorshire hills, and from the remains of some of the Old Red beds themselves. 3. The water-worn fragments of shelly rock referred to may possibly be portions of some of the fossiliferous lower tilestones, with *Holopella*, &c.

Geology of Callander.—"Sir,—I should feel much obliged if you would inform me, whether the Old Red Sandstone in the neighbourhood of Callander, N.B., is fossiliferous; and if so, I should be glad of some information as to the prevailing species to be found there. Perhaps some reader of the Geologist would kindly inform me.—Yours, J. R. Stockport."

Bituminous Shales of Scotland.—"Sir,—I should be obliged if any of your correspondents acquainted with the bituminous shales of Scotland, more especially any residing in the neighbourhood of Bathgate, would inform me if the very bituminous shale found in that, and other such localities, are not abundantly supplied with fish remains, concluding, as I do, that the inflammable specimens I have seen must be derived from that source, viz., the exudation from fish-remains.—G. W., Wakefield."

GEOLOGY OF SOUTH STAFFORDSHIRE.—A lecture on the Geologyof South Staffordshire was delivered on the 28th June, by Henry Beckett, Esq., at the Working Men's Institution, Wolverhampton. It was delivered in a very familiar and easy manner, and is printed in full in the 'Dudley and Midland Counties Express,' of 3rd July. The lecturer gave a very popular and simple sketch of the chief geological features, and dwelt at some length on the formation and nature of coal; the formation of iron; and concluded with an account of the Wenlock and Dudley limestones, and a review of the causes which had produced the physical condition of the strata of that district.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

PROCEEDINGS OF THE GEOLOGICAL SOCIETY OF LONDON.—June 23, 1858.—1. "On some points in the History and Formation of Etna." By Dr. H. Abich, For. Memb. G.S. (In a letter to Sir C. Lyell, F.G.S.)

In this letter the author explained his views of the stratification of the rocks in the Val di Bove, of the distribution, nature, and effects of the dykes, and the different characters of the lavas of successive ages in Etna, and stated his belief that the Val di Bove had originated in subsidence; and, pointing out the value of the peculiar outline of the mountain as illustrative of the double-coned origin of Etna, he described some dykes and rents that have been connected with the catastrophe, followed by the formation of the Val di Bove, which gave the chief features to Etna in its modern form.

2. "On the Lacustrine or Karéwah Deposits of Kashmir." By H. H. Godwin-Austen, Lieut. H.M. 24th Reg., Kashmir Survey. Communicated by R. Godwin-Austen, Esq., F.G.S.

The author, in going up the Jhelum to Baramula, observed great quantities of granitic boulders at Kuthai, Oorie, and Gingle, where the river-valley widens out after having been narrowed by gorges. These blocks occur throughout the whole thickness of the Alluvium, sometimes upwards of 200 feet, as seen in the sections where the nullahs cut through it. Mr. Vigne had supposed that these granite-boulders were originally brought across the Valley of Kashmir from Haramuk by ice or some other transporting agency, but the author observed no trace of such fragments along the supposed line of transport, except at the isolated localities above-mentioned. In pursuing his journey up the Jhelum by Baramual and Sopur through North Kashmir to the North Punjal Range, which he was occupied in surveying, the author was enabled to study the nature of the great alluvial deposits of Kashmir, constituting a formation of great thickness, and of which the Karéwah Hills, sometimes upwards of 300 feet in height, are formed. This alluvium or "Karéwah formation" is believed by Mr. H. Godwin-Austen to be purely of lacustrine origin. He found that it is always composed of detritus of local origin, containing granitic, basaltic, or calcareous fragments, according to the nature of the mountains in the back-ground, from which the materials had been derived; and that the coarser constituents lie near the mountains, whilst finer and finer detritus is discernible in the beds towards the plains. Subsequently examining the heights above the Jhelum outside the Baramula Pass, the author found the granitic rocks in place from whence the granite-boulders of the valley-deposits at Kuthai, Oorie, and Gingle had been derived. A journey through the Valley of Kashmir, past the old buried city, and by Islamabad and Shahbad, to survey the country traversed by the Chunab and Kishtwar Rivers, and overlooked by the Brahma Mountain, 22,000 feet high, still further illustrated the author's views of the local origin of the great alluvial or lacustrine deposits of the country—which, whether formed in the outer and smaller basins, or in the great Kashmir Valley, appear to have been the slow result of atmospheric agencies, operating on this very ancient land, from the time of its first exposure as a highly dislocated tract of tertiary and secondary strata, entangled in an irregular trough or basin of crystalline and granitic rocks, until the period when the gradual disintegration of the surface had filled up the step-like cavities with local lacustrine deposits. Subsequently the drainage of the country has not only shaped the Karéwah Hills out of these sediments, but has cut through these deposits, often deep into the underlying rock, and, clearing out the gravels and boulders from the choked gorges of the Jhelum at Baramula, has reduced the waters of the old lake of Kashmir to its present narrow limits. Hence the buried condition of the old city and its temple, and other local phenomena, may be accounted for, without recourse being had to the supposition of successive subsidences and upheavals which has been sometimes advanced.

3. "On the Black Mica of the Granite of Leinster and Donegal." By the Rev. S. Haughton, F.G.S.

The black mica accompanying the white margarodite of the Leinster granite, similar mica at Ballyellin, Carlow, and the black mica found in the Poisonglen, leading to the pass of Ballygihen, in Donegal, have been carefully examined by the author, and he regards the black mica of Donegal as certainly identical with that of Carlow and Leinster, and probably the same as the black mica from Petersberg, Wermland, described as Lepidomelane by Soltmann.

4. "On an Outlier of Lias in Banffshire." By T. F. Jamieson. Esq. In a letter to Sir R. I. Murchison, V.P.G.S.

In a cutting of the Banff and Turriff Railway, about four miles to the north of Turriff, there has been exposed a thick mass of tenacious blue clay, containing *Ammonites*, *Belemnites*, *Gryphææ*, *Plagiostomata*,, and other fossils of Liassic character.

The author explained his reasons for regarding this clay as being a fragment of the Lias *in situ*, and noticed the interest belonging to it as being perhaps the most eastern Liassic outlier in Scotland.

5. "Notes on a Collection of Australian Fossils in the Museum of the Nat. Hist. Soc., Worcester." By Professor Owen, F.R.S., F.G.S.

By the examination of a series of mammalian fossils sent from the Condamine River and Darling Downs, and now in the Worcester Museum, and of casts of the cranium, upper jaw, and teeth of Macleay's "Zygomaturus," communicated by the Trustees of the Sydney Museum, Professor Owen has been able to demonstrate that this cranium belongs, as he suggested in a paper lately read before the Society, to his genus *Nototherium*, and to the species which he had dedicated to the late Sir T. Mitchell. A smaller species, provisionally named *Nototherium inerme*, was also established by Professor Owen on some of the specimens examined; but he thinks it not improbable that with additional materials it might be found that these two forms may represent the male and female of one species.

6. "On the Occurrence of some Tertiary Fossils as Chislet, near Canterbury." By John Brown, Esq., F.G.S. With Notes on the Species, by G. B. Sowerby, Esq., F.L.S.

These fossils were found by Mr. Brown in a small exposure of sand and clay beds, in a garden on a hill-side in the parish of Chislet, Kent. The beds would appear, according to Mr. Prestwich's sections of that county, to belong to his "Lower London Tertiaries;" but of the 36 species of Shells, Cirripeds, and Foraminifera met with—13 are forms found also in the Crag; 9 are English Lower Tertiary forms; 9 are Belgian Tertiary forms; and 4 are new species.

7. "On the Fossil Crustacean found by Mr. Kirkby in the Magnesian Limestone of Durham, and on a new species of Amphipod." By Spence Bate, Esq. Communicated by Dr. Falconer, F.G.S.

In this paper Mr. Bate described a new recent Amphipodous Crustacean, which he believes to represent some of the fossil crustacean remains lately described by Mr. Kirkby in the Society's Journal, under the name of *Prosoponiscus problematicus*.

8. "On *Eurypterus*." By J. W. Salter, Esq., F.G.S.

The author gave a history of what is known about this genus,—described several new or little-known species,—and observed that the range of the genus is confined to the Ludlow, Devonian, and Lower Carboniferous strata. The new species described were—*Eurypterus Symondsii*, *E. pygmæus*, *E. megalops*, *E. acuminatus*, *E. linearis*, *E. abbreviatus*, and *E. Aquila-chartacea*. *E. Scouleri*, Hibbert, *E. Cephalaspis*, Salter, *E. tetragonophthalmus*, Fischer, *E. remipes*, Dekay, and *E. lacustris*, Harlan, complete the list of the known species of this genus.

9. "Description of a New Fossil Crustacean from the Lower Greensand of Atherfield." By Charles Gould, Esq. Communicated by Professor Huxley, F.G.S.

This is a macrourous crustacean, of rare occurrence, named by the author *Mithracites Vectensis*, and is related to the equally rare *Mithracia*, of Bell (tertiary).

The next Meeting of the Society will be held November 3rd, 1858.

Malvern Naturalists' Field Club.—The members of the Malvern Naturalists' Field Club have had two excellent working days since the June meeting at Ledbury, on the 29th ult. The first of these meetings was at the Feathers, at Castlemorton, whence a large party proceeded by Castlemorton Common and Little Malvern Church to the Winds' Point, a central pass of the Malvern range; then journeying southward they examined the geological phenomena along the flanks of the Syenitic ridge; the first point of interest after the examination of the upheaval of the Llandovery (May Hill) beds at the Winds' Point, being the quarry west of the Swinyard Hill, where the Syenite is traversed by a Greenstone dyke; the party next proceeded to the fossiliferous beds of the May Hill Sandstone below the Obelisk, and thence by Bronsil Castle to the Hollybush Sandstone, on the Eastnor and Ledbury road. The Black Shales and the altered Hollybush Sandstone, east of the Valley of the White-leaved Oak, were next carefully inspected, and although the shades of evening gave notice that the time for departure was approaching, the party were not satisfied till they had rounded the Chase-end Hill, and viewed the position of the Permian deposits and lower Keuper Sandstone (waterstones) on the southern and eastern flanks of that hill.

Another meeting was held on the 15th of this month, at Cradley, and although only eight members assembled, it was the most successful working day since the formation of the club. The party met at Stifford's Bridge, and proceeded by Mr. G. McCann's extensive quarries to examine the Old Red Sandstone district in the direction of Bromyard; several quarries were visited, and one was discovered which contained abundant remains of *Cephalaspides* and *Pteraspis*. These beds were considered by the President, and by Dr. Melville, Swiney Professor of Geology, to be on the same horizon as the beds of Leyster Sprowle, between Leominster and Ludlow.

The Malvern Club has now existed for several years, and every year has proved its usefulness, in helping to promote the science of Natural History in some of its departments; particularly in Botany and Geology. Specimens of the fossils collected by the club are exhibited in their museum, which has been visited by many of the most eminent geologists from London and elsewhere.

The immediate neighbourhood of the Old Red Sandstone formation on the Herefordshire side of Malvern, led some of the active members of the club to expect that fossils peculiar to that formation might be found, and the result of their ramble rewarded their perseverance and zeal. Specimens of fish remains were discovered in the Cornstone-quarry. We are informed that since this discovery the Vice-President has found more specimens in that quarry, and also in another quarry about two miles distant, in the parish of Cradley (Herefordshire), where the specimens were quite as abundant in number and variety.

We regret to learn that this club, which has received manifold proofs of estimation in the highest quarters of science in London, should not have received from the immediate neighbourhood greater notice and support.

The second part of the transactions, now in the hands of the printer, will contain a geological paper by the President, the Rev. W. S. Symonds, F.G.S., and another on British Algæ by E. Lees, Esq., F.L.S., with three appropriate illustrations.

THE GEOLOGIST.

SEPTEMBER, 1858.

ON THE PROBABLE INFLUENCE UPON THE INTERNAL STRUCTURE OF ROCKS, OF THE MUTUAL FRICTION OF THEIR COMPONENT PARTS, WHEN FORCED INTO MOTION UNDER EXTREME PRESSURES.

By G. POULETT SCROPE, Esq., M.P., F.R.S., F.G.S., &c., &c.

(*Read before the Geological Society, May 12th*, 1858.)

IN a paper read before the Geological Society on the 23rd of April, 1856, I referred to the proofs of a "plasticity," or imperfect liquidity, in the crystalline igneous rocks at the time of their protrusion, and called attention to the mechanical changes, in texture and structure, which could not fail to have resulted from the mutual friction of the component crystals or granular particles of these rocks, during changes of volume or of position, occasioned by variations in their temperature while subjected to intense and irregular pressures.

In illustration, I referred to the "ribboned" pitchstones and trachytic lavas of Ponza, Ischia, Hungary, Mexico, &c., in which this structure had unquestionably been produced in that manner, and I repeated the opinion (to which more than thirty years back I had given expression), that to such *internal friction* of the component crystals, was probably owing the foliation of gneiss and mica-schist; through the "squeeze and jam" to which the lateral portions of an eruptive granitic axis must have been subjected, between its own expansive force and the resistance and pressure of the overlying strata.

The subject has so important a bearing on Geological Dynamics and the doctrine of Metamorphism, that I trust to be excused for carrying the inquiry a little further. In doing so it will be well to begin by some elementary considerations.

It is the well-known property of most substances to pass from a solid to a liquid state, and vice versâ, under varying circumstances of temperature and pressure. But there is an intermediate condition of *imperfect* liquidity, in which the component particles of a substance possess only a modified mobility, or capability of movement *inter se* under sufficient pressures. Some substances, apparently homogeneous, exhibit this imperfect mobility at ordinary temperatures; for example, honey, pitch, and generally what are called viscous substances. Where the substance is not homogeneous, but consists of more or less solid particles mixed or suspended in a liquid, the mobility of the particles and the liquidity of the mass, of course, very much depend on the proportion of the solid to the liquid parts, as well as on the size and shape of the former, and the degree of fluidity of the latter elements.

Even in the most liquid substances the mobility of the particles is attended by more or less of friction, occasioned by their mutual pressure. When the particles are homogeneous, equal in size, and spherical, as is probably the case in all perfect fluids, the friction accompanying their motion, other circumstances remaining the same, will be least. Where all, or any considerable proportion of them, are unequal in size, or irregular in form, the friction must be proportionately great.

When ordinary liquids, such as water, are put in motion by any force, the whole body of liquid does not move together at the same rate and in the same direction. Either from the movement being communicated to one part before it reaches another, or owing to the resistance offered by the containing surfaces to the motion of the contiguous particles, and propagated through them to the others with which they are in contact, and so on, irregularities of pressure, and, therefore, of mutual friction, are produced, and, consequently, unequal rates of motion in different threads or veins of the liquid. Hence all the phenomena of currents and eddies.

When coarse or solid particles of matter are suspended or mixed in a moving liquid, they likewise offer more or less of resistance to the motion of the more mobile particles in contact with, or contiguous to them, and occasion similar internal irregularities of motion. They move together with, but less readily, and consequently more slowly than, the latter, which, by the pressure and friction thus occasioned, are squeezed, as it were, from among the coarser or more solid particles, and take a line of their own, moving more rapidly than the former, while these hang back. And thus the stream of liquid moving in any general direction tends to divide itself, more or less, into veins or threads composed of particles of different degrees of coarseness, and, consequently, of different degrees of mobility, and moving at different rates. Moreover, by the friction which accompanies, or rather occasions, this separation of particles of unequal mobility and unequal rate of motion, the coarser suspended particles are turned about until their longer axes are brought to coincide generally with the direction of the movement; and they are led to arrange themselves in strings or trains, one behind, or in the wake of the other.

This is visible to any one who looks down from a bridge or other height on a running stream, upon whose surface float sticks, straws, or foam. These matters are seen to arrange themselves in streaks or linear bands in the direction of the movement, whether of the general stream or of its superficial eddies, the streaks being separated by others consisting of water comparatively free from foreign matter, and moving more rapidly than the former.

If the floating or suspended substances be susceptible of tension, and the moving force is sufficiently powerful, they will be drawn or squeezed out by the pressure and friction to which they are subjected so as, if circular in outline, to become oval, if globular, ellipsoidal; and of whatever form they be, they will be elongated in the direction of the movement and contracted in their other dimensions, until, if the motion and pressure and consequent friction be sufficient, they become extenuated into long threads, stripes, or planes, having the direction of the motion impressed on them; which direction may be occasionally varied so as to produce wavy, sinuous, or contorted shapes, under varying conditions of friction or lateral pressure.

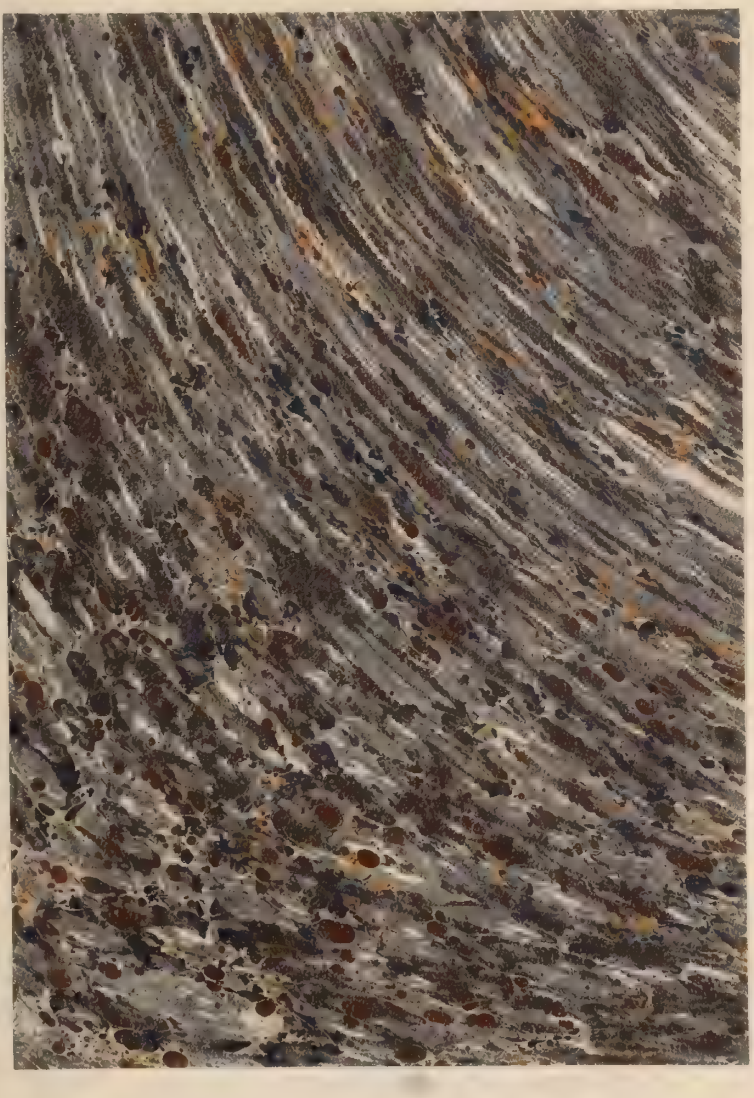
This law, which may be called that of "differential motion," in particles of different sizes and shapes, and consequently of different degrees of mobility, when set in motion within a more or less imperfect liquid, may be illustrated by the hand specimens of marbled paper which I here exhibit (Pl. x.). In them the ribboned appearance is produced by merely forcing the colours, as they float on the surface of water in films of circular or irregular shapes, to move in a lateral direction, by which motion their outlines are, as is here seen, elongated or stretched into parallel lines of more or less regularity, according to the greater or less resistance or retarding influence offered by each to the movement of its neighbour. The result being the production, on the surface of the fluid, of an arrangement which very closely resembles that of sections of the ribboned lavas and trachytes upon the table from Ponza, Ischia, the Ascension Isles, &c., as well as those of gneiss and mica-schist. The irregularities of movement caused by variations of pressure occasion evidently those accidental wavings and re-plications which are seen here, and which are also so frequent in the laminated or schistose rocks to which I have compared them.

It may be said that the ribboned veining in this case is merely superficial, whereas in the rocks it penetrates their substance throughout. But so it equally would in the first case if the colours, instead of merely floating on the surface of the liquid, were suspended in it throughout. The internal patches would then be similarly drawn out in the direction of the movement, as we see the superficial ones to be, and the same ribboned appearance would be produced in a vertical plane or section which we here see produced in a horizontal one. An example of this result may, indeed, be observed in the fractured edges of many coarse kinds of pottery or pantile. The squeeze to which the clay has been subjected when pressed into the mould having, in some places, dragged or pulled out such portions as happened to be of different consistency from the rest into stripes or veins, which give a ribboned grain to the material.

The same ribboned structure may often be seen in the slags of iron and of glass furnaces, as well as in some peculiar varieties of coloured or enamelled glass, especially among the old Venetian enamels.

Even where the substance is composed entirely of solid particles, if they are of different sizes and shapes, their subjection to pressure tends to produce a similar structural arrangement, as when a heavy roller is passed over gravel consisting of fragments of rocks or pebbles and sand of different shapes and sizes. The finer and more globular particles yield most readily to the pressure, and are squeezed out, in a manner, from among the coarser, which themselves slide more or less over each other, and are turned round so as to lie with their flatter faces in the plane of the surface, that is, perpendicular to the direction of the pressure. If a certain amount of moisture be present (as when gravel is rolled after a shower of rain) this internal mobility of the materials is increased, and the laminar arrangement facilitated by the lubricating effect of the liquid.

PLATE X.



PAPER MARBLED BY ACTUAL COMPRESSION OF THE FLOATING COLOURS
TO ILLUSTRATE THE
RIBBONED-STRUCTURE OF GNEISSIC ROCKS.

Mr. Sorby's experiments, in which he produced slaty lamination in a mixture of pipe-clay and glue containing flattened particles of mica or oxyde of iron, by subjecting it to a squeeze, exhibit the same result.

We may now proceed to apply these considerations to the case of the crystalline rocks of igneous origin. It has been calculated that granite must lose one-tenth of its bulk in the process of crystallization or consolidation from a state of fluidity. Then, on the other hand, it must augment in volume by one-tenth on passing from a solid to a fluid state. Whether this be the precise proportion or not, it is quite certain that the changes of temperature to which granite and all other igneous rocks have been exposed, must have been accompanied by a corresponding change of volume, even while its component minerals still retained their crystalline state. But every such dilatation or compression must occasion a considerable amount of motion and consequent friction of the component crystals *inter se*. If, as there is great reason to believe, water has been always present throughout the crystalline igneous rocks, holding much silex in solution, perhaps in a gelatinous state, this will have acted as a lubricator to the more solid and still crystalline minerals, and enabled them to move among themselves in a considerable degree without being completely broken up, as might be otherwise expected, from the amount of friction to which every change of volume must have subjected them. Under such circumstances, we can conceive a mass of crystalline rock to undergo considerable dilatation through an increase of temperature without much change in the form or position of its component crystals, on the supposition that the pressures to which it is exposed be nearly equal on all sides, and consequently its expansion nearly equal in all directions; although, in this case, many fractures, cracks, and crevices occasioning a brecciated or veined structure may be produced. But, should such an expanding mass force its way upwards through a rent broken across a vast weight of overlying strata, tilting these latter and shouldering them off on either side, the upper and lateral portions of the elevated mass must be subjected to such an oblique and unequal strain or squeeze between the downward pressure, and perhaps lateral movements, of the tilted strata and the upward thrust of the axial crystalline mass, as must tend to break up more or less the component solid particles or crystals of these lateral portions, and arrange their fragments with their longest axes in the direction of the movement, and in planes perpendicular, or rather diagonal, to the opposite pressures—the different crystalline elements separating into more or less distinct bands or laminæ, according as their forms permitted them to move with greater or less freedom. The silex, if in a gelatinous condition, would possess the greatest mobility, and act as a lubricator to the other minerals. But the mica plates, likewise, would probably slip or slide readily over one another when brought by pressure and friction into parallel planes, and the rectangular crystals of felspar would be likely to offer the greatest resistance to the motion, and be therefore broken up in part, and dragged into those layers or stripes which are characteristic of the position of this mineral in gneiss. Where the pressure and friction was extreme, as towards the outer sides of the erupted mass, the felspar might be so comminuted as to be undistinguishable, or be taken up, perhaps, into the silicate, which, with the mica, would then appear to constitute the entire rock, so as to present ultimately the structure and composition of *Mica-schist;* while the irregularities of friction being equally extreme in the same parts would be likely to occasion multiplied wavings and convolutions on the small as well as large scale, such as we see in that rock, as well as in serpentines and other of the so-called metamorphic schists.

Further yielding of the mass to pressure, occasioning internal movements, after more or less of consolidation, or even the mere shrinkage during that process, might give rise to cracks and fissures, which, being filled by infiltration of the silicate from the proximate parts, would occasion the quartz veins so frequent in these crystalline schists.

It is submitted whether such a purely mechanical re-arrangement as is here indicated, and which would seem from *à priori* reasoning absolutely a necessary accompaniment of the protrusion of any subterranean granitic axis, by internal dilatation from increased temperature, through disrupted overlying rocks, does not offer a more probable explanation of the foliated structure of the (so-called) metamorphic schists than the supposition that it is merely the original sedimentary bedding of otherwise wholly metamorphosed strata? It seems difficult to understand that exposure to an amount of heat and pressure infinitely greater than that which, in the argillaceous schists, has nearly obliterated all traces of the original bedding, should in mica-schist and gneiss have rendered it only more distinct and decided.

That these are, or may be, metamorphic rocks, derived, that is, from the fusion and re-consolidation in a crystalline state of sedimentary strata, is a theory not here called in question. My suggestion only amounts to this, that their foliation does not represent the original sedimentary bedding, but was brought about by the internal friction of their already crystallized particles during protrusion or elevation, under circumstances of intense pressure and lateral motion in opposite or nearly opposite directions.

It is not inconsistent with this view to admit that a certain amount of crystallization may have accompanied or followed these internal movements. For it is known that some freedom of motion is necessary to the exercise of the crystallific action, and also that the atomic particles must be brought within certain small distances. Now, during the internal movements to which I have referred, some of the disaggregated mineral elements may be brought so close together as to cause crystallization to take place. And thus new and even large crystals may be formed in the midst of granular or amorphous matter. In many of the crystalline schists, as well as in some clinkstone and felspar porphyries, we find lengthened crystals whose acicular and delicate, but unbroken, form renders it difficult to suppose them to have undergone, since their production, any great amount of friction. If we suppose these to have crystallized while the mass of which they form part was subjected to a certain amount of motion under intense pressure, it will be obvious that their major axes should be found (as I believe they invariably are) in planes more or less perpendicular to the direction of the pressure, and corresponding to that of the movement (as indicated by the foliation of the rock), since the mobility necessary to the crystallific action will have been freest in that direction.

I may remark that the influence of internal friction, caused by movements under extreme and irregular pressure, must be equally operative in the case of rocks of aqueous as in those of igneous origin—of shales, limestones, and grits, as well as of granites or trachytes, under similar circumstances of imperfect liquidity, irrespective of change of temperature.

There is every reason to believe that many of the sedimentary strata were, at the time of their elevation above the levels at which they were deposited, in a more or less soft and semi-liquid condition, permeated with water, and consequently liable to much internal and irregular movement among their solid particles, under the action of the enormous and irregular pressures to which, during their elevation, they must have been subjected. When the component particles of any bed were of an argillaceous character, and therefore capable of combining with water into a slippery paste, or where a large proportion of them were of a flattened form, as in the micaceous shales, they will necessarily have yielded so readily to oblique pressures, by sliding or slipping over each other, as to give rise to a highly lamellar arrangement, the planes of the laminæ taking the direction of the movement. Moreover, the entire mass itself will have been proportionately extended, or flattened out, in the same direction, and contracted in its opposite dimension. And thus was probably occasioned the "cleavage" of the slate rocks. The artificial production of cleavage in wax by Professor Houghton, and of laminated stone by Mr. Sorby, have shown experimentally that pressure will give rise to this lamellar structure in substances composed of scaly or flaky particles possessing a certain mobility *inter se.*

But while the micaceous or argillaceous beds were thus yielding to pressure, and stretching their dimensions in a direction perpendicular or diagonal to it, the coarser conglomerates and calcareous strata, whose component solid particles did not allow of so much internal motion, will have been rather broken up by the formation of cracks and crevices throughout their substance, under the influence of irregular pressures. And in this manner, probably, quite as much as by shrinkage, was produced the veined and brecciated structure of such of these rocks as have been subjected to considerable disturbance—viz., the veined marbles, some serpentines, the calcareous breccias, and quartzose sandstones.

In every class of rock, I may observe, whether igneous or aqueous, observation will, I think, show that the internal structure which I am here referring to internal friction accompanying movement under extreme pressure, preceded the concretionary separation of the substance by joints or seams into prismatic or other divisional forms.

I will not pursue the subject further at present, my object being merely to urge the attention of geologists, especially when working in the field, to the mechanical influence that must have been exercised on the internal structure of rocks of all kinds which have suffered much change of position since their formation, by the internal movements occasioned in them by intense and irregular pressures.

CONTRIBUTIONS TO THE GEOLOGY OF GLOUCESTERSHIRE.

By the Rev. P. B. Brodie, M.A., F.G.S., &c., &c.

(*Continued from page* 233.)

As the Lias in this county is a very bad material for economical purposes, it is not often extensively quarried; and, considering the few available sections, the number and variety of organic remains which have been, from time to time, collected, are really remarkable, and show the prolific nature of the sea of that period. Some localities in that sea, of course, would be richer than others, as is the case in the present day; but, on the whole, this formation is everywhere marked by a great abundance and diversity of fossils. The Palæontologist often looks with a longing eye at some old quarry, long since closed, which had been at one time famous for its zoological contents, and speculates upon the wonders which lie concealed beneath his feet; and he restores in thought some ancient monster of the deep, some curiously-formed shell, or some strange plant; and perhaps, if he had the power, he would dig away, in the hope of possessing some of these treasures which his imagination has conjured up before him. And yet, after all, such speculations are not so imaginative or unreal as they may at first sight appear, for the strange and extraordinary forms of extinct life, which the extended researches of scientific inquirers have brought to light, seem to justify the highest flights of fancy; and none can tell when or where some wonderful relic of the past may be found. This is equally true of the organic contents of each of the different formations which constitute the earth's crust; but to none of them is it more applicable than to the Lias itself, when, like a later geological period, as I have before remarked, the Wealden, gigantic reptiles (in the one case marine and the other terrestrial) were the lords of creation, and the vast size and ferocious habits of the predaceous species must have made them the scourge and terror of the smaller creatures with which they were associated. Of late years, many interesting discoveries of this nature have been made; and, although railway excavations are now of rare occurrence, we may still anticipate fresh additions to our knowledge, and even the smallest quarry may yield some interesting novelty to the hammer of the patient and persevering collector. Now, the facts which we shall have to note in the history of the lower division of the Lias will confirm the truth of this assertion, and at the same time afford encouragement to the beginner to go on his way rejoicing, while he scrambles over rugged rocks, and finds himself lost for awhile amidst the changes and contortions which the strata in mountainous regions so frequently undergo. This, we need not say, does not apply to the Lias; for except in the Alps and a few other similar places abroad, this formation has undergone but little disturbance; and that portion of it in Gloucestershire now to be described scarcely rises into hills, and has been subject to little or no alteration in its internal structure since its original deposition.

We have already described the Upper Lias, the marlstone, and the beds more immediately below; and we have seen that they each contain a certain number of peculiar fossils, marking distinct stages of life; and the same remark applies with equal force to the lower and succeeding divisions. Owing unfortunately to the paucity of sections, many of these are very rarely exposed in the district—never in one consecutive section—and are chiefly to be observed in the few clay-pits where bricks are made around the town of Cheltenham. At the foot of Battledown Hill, there is a stratum of yellow clay, about four feet thick, enclosing ferruginous nodules, in which a variety of shells have been met with, viz., *Belemnites elongatus, Trochus imbricatus,* a species of *Gervillia, Cardinia attenuata, Modiola cuneata, Spirifer punctatus, Arca gracilis, A. Buckani, A. truncata, Avicula inequivalvis,* and some others, a portion of which are not recognized elsewhere. Unfortunately the pit is now only worked in the lower clays, so that the more peculiar fossils of the yellow clay cannot be obtained. The former are best exposed in a brick pit on the left hand, nearer Cheltenham, and these laminated strata of blue clay are the commencement of the Lower Lias Shale. It is characterised by *Ammonites Henleyi, A. Conybeari, A. crenata,* and others, with *Perna ventricosa.* Below this, the four following beds occur, which are each distinguished by the prevalence of certain fossils, met with in greater or less abundance. Thus, according to Professor Buckman, we have the "Belemnite-bed," twelve feet thick, which is succeeded by another yellowish clay, charged with many species of *Ammonites,* and not exceeding three feet in thickness; then strata of dark shale, ten feet thick, marked by a great abundance of a peculiar shell, the *Hippopodium** *ponderosum,* many specimens of which may still be found on the spoil-banks of the Midland Railway, about a mile from the station, on the way to Gloucester. The fourth band is designated the "Cardinia-bed." This shell (Cardinia), a very characteristic genus in the Lias, was formerly confounded with *Unio*; and to this division the large *C. Listeri* appears to be confined. All the above may be seen in the several brick-pits around Cheltenham, and in the railway cuttings. The last bed also appears in some brick-pits at Cleeve. Univalves are nowhere very numerous; but a fine species of *Pleurotomaria* (*P. Anglica*,) is, in places, not unfrequent; and sometimes groups of minute univalves also occur. Ammonites and Belemnites are generally very abundant, and a beautiful species of Nautilus, (*N. striatus*,) besides three species of *Gryphæa*, the well-known *G. incurva* being the most frequent. Some small *Cidarides* have been discovered, and an *Astacus*, tolerably perfect, with remains of *Pentacrinites*, and a large specimen of *Sepia*, with the enclosed ink-bag.

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* So called from its resemblance to a horse's hoof. It appears to be allied to Cypricardia or Cardita, and belongs to the same family as Cardinia, another abundant and still more characteristic Liassic form.—P. B. B.

It is only in a few sections, here and there, that these argillaceous bands can be traced; but the order of succession has been carefully determined, as well as their organic contents. In some of the ramifying valleys between the hills round Cheltenham patches of Lower Lias may be observed, but the Vale of Gloucester, and the slopes leading to it, are undoubtedly the best places for studying the lower portion of this deposit. The prevailing fossils are marine shells, and but rarely traces of fish or saurians. Indeed, very few fish have been discovered in this neighbourhood, which, in this respect, presents a striking contrast to the equivalent beds at Lyme, in Dorsetshire, where layers of shale are literally made up of entire and broken specimens of that class. Below these clays we have a succession of rubbly, white, and compact blue limestones, alternating with dark shales, which are, more or less, fossiliferous, and which are well marked by a very large species of *Plagiostoma*, (*P. giganteum*.) Many fine specimens were formerly to be procured from a quarry at Piff's Elm, between Cheltenham and Tewkesbury. Associated with them are numerous shells of *Cardinia ovalis*, *Astarte lurida*, and *Terebratula rimosa*. Whenever stone is wanted in the plains of Gloucester, this limestone series* is exposed;

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* This division is well displayed at Fretherne Cliff, near Newnham (a station on the Great Western Railway between Gloucester and Chepstow); and the student should by all means go there, as it affords a better and thicker section than can

and though the upper part makes but a poor road-stone, the lower affords a tolerable building material, and slabs of large size are sometimes quarried. At Norton and Coomb Hill, and still farther on the road towards Tewkesbury, and at Brockeridge Common, near that town, and thence to Defford, these strata may be traced, and many pits are worked; and the student, in order to make himself acquainted with them, should trace them from the latter place, following the line of quarries to Brockeridge. In this part of the series, the greatest number of saurian reptiles have been found, even entire skeletons of the most frequent species of *Ichthyosaurus* and *Plesiosaurus*, the *I. communis* and *P. dolichodeirus.* The presence of these marine lizards indicates a somewhat different condition of the sea at that period; and the wonderful state of preservation in which they have been discovered, probably shows that they were suddenly entombed and rapidly covered up in the calcareous mud with which the waters were highly charged. It is a curious fact that in all parts of the world where the Lias is present, the remains of these formidable reptiles have been met with, proving their wide and extensive distribution throughout the sea at that epoch. Their fierce and predaceous habits have been already alluded to; and a few observations may now be added with regard to their structure. The jaws of the Ichthyosaurus were armed with pointed teeth; the eyes were of great size, protected by moveable sclerotic bony plates, and possessed of great and very distinct powers of vision, beautifully adapted to the nature of a reptile which inhabited deep as well as shallow water, and occasionally, also, basking on the shore. The head was unusually large, and the neck comparatively short; the vertebræ were so constructed that they permitted quick and rapid motion, after the manner of fishes. The tail was long and tapering, with a vertically-placed terminal fin. The movements of the body were ably aided by four paddles. Thus, in all its parts, this creature combined the characters of a fish and a reptile. The largest specimens must have attained the length of upwards of forty feet, and may truly be affirmed to have been the most formidable monsters of the ancient deep. The

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be seen elsewhere; and many fossils may be procured. There is, also, a small patch of Lias, still higher in the series, at Pyrton, on the opposite side of the Severn, full of fossils; and this spot is particularly interesting, as it exhibits the junction of the Lias with the upper Ludlow rocks, which are brought up here by a fault and crop out on the banks of the river a little further to the west.—P. B. B.

Plesiosaurus differed from the *Ichthyosaurus* in its long, swan-like neck, in its extended paddles, short tail, and small head, which it must have raised high above the water like a swan's; and although a carnivorous reptile, it was altogether unable to cope with the *Ichthyosaurus*, its most dreaded foe. Both these genera were covered with a tough smooth skin, and not with scales, as we might have imagined; and this we know from the discovery of a portion of the skin attached to the skeleton of an *Ichthyosaurus*, from the Lower Lias at Barrow-on-Soar, in Leicestershire.

The student must not expect to obtain a perfect specimen of one of these reptiles without considerable labour and perseverance; for when one is found entire, much skill and patience is required to clear away the hard matrix which surrounds it, and many an hour has to be devoted to the development of even a single bone; and some knowledge of its anatomy also is requisite, especially when, as it often happens, a specimen has been broken up into innumerable and disjointed fragments, which all have to be correctly united before a full restoration of the original can be completed. In this way Cuvier and Owen have restored the entire skeleton of several extinct animals, even from heaps of bones piled together as in a charnel-house; so that magically, as it were, at the bidding of the comparative anatomist, each bone has assumed its right place, and from its internal skeleton, thus remodelled, the external form and habits of the creature as living have been fairly demonstrated. It is, indeed, a wonderful power which God has thus given to man, as the reward of patient study and anxious thought, thus to rebuild the creatures of the past.

The strata in which these saurians are met with are not usually rich in other fossil remains, though the surface of the limestone is sometimes crowded with *Modiola minima*, and small oysters; and at Brockeridge Common the blue strata are charged with *Ammonites planorbis*, which often retains the nacreous pearly material of the shell, giving it a very beautiful appearance, like opal. The total thickness of this part of the series is about fifteen feet, having a dip of fifteen degrees to the east at Defford and at Brockeridge. The entire thickness of the Lower Lias is very considerable, quite six hundred feet, or even more, but much less in the south and south-east districts.

We have now arrived, in descending order, at the "basement-beds" of the Lias, the lowest of which rest immediately on the Red Marl, belonging to the New Red Sandstone formation. These "basement-beds" present many features of novelty and interest, as might be expected from their position. They usually lie at some depth, and have, in most cases, been brought to the surface either by a gradual upheaval of the inferior deposit, or else they crop out in their due order as they approach the Red Marl. While, therefore, the major portion of the Lower Lias spreads over the Vale of Gloucester, and constitutes a level tract of country, the lowest part forms low undulating hills, which become a prominent feature in the landscape, especially when it presents bold cliffs on the banks of the Severn, as at Wainlode, four miles north of Gloucester; at Westbury, seven miles south-west of that city; and again at Aust-passage, near Bristol. At Wainlode there are about thirty-five feet of Lias overlying sixty-five feet of Red and Green Marls. Near the summit below a mass of black clay is a thin band of hard limestone, full of oysters and modiolæ, succeeded by ten inches of yellow shale, below which occurs a layer of limestone, having a laminated structure, but very hard when not weathered, in which, many years ago, we discovered the first remains of insects in the Lias of this district, and which have since been obtained in greater or less abundance wherever the same limestone has been quarried in its extension into Somersetshire, Worcestershire, and Warwickshire. In Gloucestershire, for the most part, it consists of one stratum of stone not exceeding two feet in thickness; and although in the counties of Worcester, Warwick, and Leicester, there are three or four beds divided by shale, its lithological characters are identical, and it is thus readily recognized, independently of its peculiar and distinctive organisms, which differ widely from those of the other limestones in this group. At Garden Cliff, Westbury-on-Severn, it is full two feet thick, and is loaded with a profusion of *Monotis decussata,* a small bivalve shell belonging to the family Aviculidæ, and a few remnants of insects. From Wainlode it may be traced to Hasfield, on the opposite side of the river, Apperley, Norton, Coombe Hill, Forthampton, near Tewkesbury, and thence by Brockeridge, Strensham, and Defford. Very few shells occur with the insects, and those chiefly ostrea and modiolæ, and rarely monotis, but they are generally associated with a decapod crustacean, *Eryon Barroviensis,* which, in Warwickshire, attains a large size, and is in a good state of preservation. A few fish, though still rare, have been found in this limestone; and in Warwickshire and Leicestershire it is particularly rich in remains of this class, among which the genera Dapedium and Tetragonolepis—fishes of the Ganoid order, having bright enamelled scales, and resembling the turbot in shape—are the most prevalent. Fragments of plants, too, are more numerous than in any other division of the Lias in Gloucestershire, among which may be enumerated the following genera: *Otopteris obtusa,* and *O. acuminata, Equisetum Brodiei, Cupressus ? latifolia, Hippurites ?* traces of Confervæ, Musci and Umbelliferæ, an assemblage of acotyledonous and dicotyledonous forms, not met with elsewhere in the Lias. The insect relics consist chiefly of elytra or wing-covers of several orders of Coleoptera; a few perfect small beetles have been detected. There are wings and legs of Orthoptera, Neuroptera, Hemiptera, and Diptera. Perfect insects, of course, are rare, but a few have been procured with the wings and legs attached, the delicate markings and nervures of the former being well preserved; but the wings of Neuroptera are the most abundant, and the single elytra of Coleoptera.* These remains are always to be found in this particular stratum, whence we have denominated it "Insect Limestone"; and they sufficiently distinguish it from all others, either above or below. Wainlode Cliff, Apperley (the grey hill), and Strensham were, perhaps, the richest localities; but, unfortunately, the two latter are now no longer available, as the quarries have been closed for some time. These and the other localities in Gloucestershire, are none of them very far from the Malvern and other hills, where more ancient rocks prevail; and we are naturally led to the inference that they formed a portion, at least, of that land where the insects lived, and from whence they were carried by rivers into the ocean, by which it was bounded. The presence of a variety of terrestrial plants, though very fragmentary, leads to the same conclusion. We might enlarge upon the subject, and say a great deal more about these insect treasures; but we must defer this until some future opportunity. But this is not the only interesting bed in this part of the series. The insect limestone is succeeded at Wainlode Cliff by about five feet of marly clay, which is underlaid by eight inches of hard, yellow, nodular limestone, of an irregular fracture, having a singular waved and variegated character, so that it has obtained the name of landscape-stone, near Bristol, where it is frequently quarried, and used for ornamental purposes. It contains a small bivalve, which may be a fresh-water shell Cypris,* and three species of Monocotyledonous aquatic plants belonging to the family Naiades, some genera of which may still be observed in ponds and ditches, though others inhabit the sea. This limestone is readily recognized by its position, fossils and lithological structure, and is distinct from the overlying band. It is well exhibited at Wainlode, Westbury, and Aust Passage, where it is considerably thicker, and contains some well-preserved insects and two new species of small fish. Twelve feet of yellow clay and black shale divide the above from the celebrated "bone-bed," of which there are two layers at Wainlode Cliff, the upper one being a hard sandstone, the surface of which is covered with various markings and tracks of mollusks and marine worms, and the other, about ten feet lower, of a dark colour, full of pyrites, and almost composed of bones, teeth, and scales of fish and saurians; at Coombe Hill, Westbury, and Aust it is much thicker, and contains some singular palatal teeth of Ceratodus. Two feet of black shale separate this from the green and red marls of the Trias, or New Red system. From the characters of the fossils which mark these "bone-beds," it has been inferred that they would be more correctly assigned to the Trias; at all events, there is something peculiar and distinctive about them; and it is a striking fact that though sometimes blended together, they can be traced even into Wales, the main mass still being made up of bones, scales, teeth, and coprolites of fish and saurians. The quantity of phosphatic matter, indeed, is in places so considerable that it might be used profitably as a manure, if it were not so strongly impregnated with pyrites. A good deal might be said about the history of these "bone-beds,"† which are known in other formations as well as the Lias, when similar conditions seem to have prevailed at distinct and widely distant intervals of time in the early history of our globe. In concluding the account of the Lias in Gloucestershire, we may, for one moment, carry our thoughts back to the state of the land and water during its deposition. The sea must have been highly charged with calcareous matter, usually making an accumulation of shale and clay, and being less frequently consolidated into limestone, while there was a great abundance of marine animals, especially gigantic Cephalopods, of which the Ammonite, Belemnite, and Sepia were the predominant forms. The sea, too, was probably, during most part of the Liassic era, of considerable depth, many parts of which must have resembled a garden of flowers, from the groves of beautiful Pentacrinites, bending their graceful heads with outstretched arms to seize their food. Amongst these many strange species of fish disported themselves, until dispersed in flying shoals as they sought to escape the capacious jaws of some hungry saurian in search of prey. We know from the occurrence of plants and insects and the bones of Pterodactyles that the land and air had their strange inhabitants, and that, in many cases, the coast-line was not far distant whence the rivers conveyed their relics into the ocean; and the contiguity of the insect-limestones in most localities in Gloucestershire to rocks of greater antiquity indicates, with something like certainty, where the old land might be looked for, though, as to its extent or general outline, it is, of course, now impossible even to conjecture. We must be satisfied to search for truth in a humble, patient spirit, while we contemplate with wonder and delight the marvellous records of the past, which is indeed as a fairy scene seemingly rising up and passing away from us as in a dream.

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* Figures and descriptions of many of these will be seen in Brodie's "Fossil Insects," pls. 6—10.

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* Fresh-water crustacea inhabiting a bivalve shell.

† A very probable view of the origin of these "bone beds" is given in "Stones of the Valley," page 18, an able and interesting work lately published by my friend, the Rev. W. S. Symonds, F.G.S., Rector of Pendock.—P. B. B.

NOTES OF A GEOLOGIST IN IRELAND DURING AUGUST AND SEPTEMBER, 1857.

By the Rev. W. S. SYMONDS, Rector of Pendock, and President of the Malvern Natural History Field Club.

(*Continued from page* 335.)

A NOTICE of the geology around Killarney having already appeared in the GEOLOGIST, by "A Brother of the Hammer," it will be sufficient for us to indicate the best localities for sections and fossils, premising that the upper and lower Old Red Sandstone are unequivocally represented in Ireland, independently of the upper groups of conglomerates, and red and yellow sandstones.

The Old Red Conglomerate in Ireland is in many places unconformable to the Old Red Sandstone, and constitutes the base of the carboniferous deposits; and I had been assured that the same unconformability had been detected in the Forest of Dean; but a careful examination, with Dr. Melville, has since convinced me that there is no such unconformability between the Upper Brownstones and the overlying masses of conglomerates and red and yellow sandstones in this or the Blorenge district. In Ireland the local geologists persist in limiting the term Old Red Sandstone to a series of deposits which there most certainly pertain more to the carboniferous group, viz., the conglomerates, red sandstones, and yellow and grey sandstones, which pass upwards conformably into the Coonahola grits and carboniferous slates. The equivalents of our cornstones and brownstones of Brecon and Monmouth may be studied at Glengariff, at the head of Bantry Bay, where the lowest rocks seen are the Glengariff grits, or upper cornstones, overlaid by the Dingle slates or brownstones, and the red sandstones of the conglomerate series, with no unconformability. At Muckross, near Killarney, the yellow sandstone may be seen, and it overlies the red sandstone of the conglomerate series throughout the south of Ireland. These yellow sandstone-beds are especially fossiliferous in the Kiltorkan district, and have furnished Lycopodiaceous plants, the *Sphenopteris Hibernica*, *Anodon Jukesii*, the teeth of *Dendrodus*, and a dermal plate of *Coccosteus*. They are, no doubt, the equivalents of the Dura Den beds of Scotland, of the beds in the escarpment of the Daren, near Crickowell, in Monmouthshire, where Sir R. Murchison detected a scale of the Holoptychius; and of the Farlow sandstones in Shropshire, where Mr. Baxter, of Worcester, discovered a Pterichthys. Professor Haughton exhibited some fossil stems of plants from these deposits at Hook Point, County Wexford, which were allied to Stigmaria, and curiously entwined by some climbing plant of that ancient epoch. The yellow sandstone may also be seen at Quakertown, near Mallow, *en route* from Killarney to Dublin; but the most instructive section from the cornstone series of the Old Red (Glengariff grits) to the carboniferous slates, inclusive, within the reach of Killarney, is at Bantry Bay.

"Green Erin" should be "Hospitable Erin." We were strangers in the land; so that the "Come and see me" of a distinguished and noble naturalist, who resided in the north of Ireland, sounded right pleasantly in our ears; and truly courteous and kind was the welcome he gave. We met at the Drogheda terminus, and our host, who acted as our cicerone, knew well the geological formations of the railroad-excavations through which we passed, and the history and legends of every place. To an English eye the slovenly husbandry and the paucity of timber was unpleasant; yet here and there the crops were fine, waiting to be gathered in. The harvest was come, but the labourers were not ready.

We would willingly have halted at Drogheda to visit the field of the Battle of the Boyne, which is distant about two miles from that place, but were obliged to content ourselves with humming "The crossing of the water," or we should have missed the Enniskillen coach at Newbliss.

The route from Dublin to Dundalk would have been uninteresting but for occasional views of the sea, and the history attached to many places by which we passed. The first part of the journey lay through the lower carboniferous limestone and "calp series;" and here I had another opportunity of observing the great difference in the thickness of strata of equivalent deposits, even within the limited area of Great Britain and Ireland. The "tilestones" of the Dingle beds are a very different group of rocks from the tilestones of Herefordshire and Shropshire; yet we must consider them the absolute historical equivalents. Of the Upper and Lower Silurian rocks of Northern Europe, Sir R. Murchison tells us that "thousands of feet of diversified British Silurian rocks, whether slates, schists, shales, conglomerates, sandstones, quartz-rocks, limestones, or mudstones, with vast sheets of interstratified igneous rocks, are presented in the Baltic provinces of Russia by little more than one lithological character only." "The united Lower and Upper Silurians constitute but a single volume of limestone, of small capacity and thickness, capable of division into leaves by that person only who is acquainted with their included fossils."*

In the same manner groups of strata of carboniferous age are much more expanded in Ireland than in the West of England. In the South Welsh coal-field, at Dean Forest, and at the Clee Hills in Shropshire, the red and yellow sandstones above the conglomerate are succeeded by the limestone-shale, and this by the carboniferous limestone and millstone-grit, all of which underlie the true coal-measures. In Ireland we find the yellow, and grey, and red sandstones above the conglomerate succeeded by a great thickness of dark shales passing upward into slates; a lower limestone, a middle series, with thin beds of impure coal, impure limestone, and sandstones called the "calp" series, an upper limestone, which is overlaid by a representative of the millstone-grit, and coal-measure sandstones, and shales with some bad coal.

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* Quart. Jour. Geol. Soc, Feb. 1, 1858, p. 52.

Thus we have as follows:—

1. Coal-measure series.
2. Millstone grit series.
3. Upper limestone.
4. Calp.
5. Lower limestone.
6. Carboniferous slates or shales.
7. Yellow, grey, or red sandstones.
8. Sandstones and conglomerates.

Fossils also are not wanting to determine the age of the lowest of these rocks, the yellow and red sandstones having furnished shells of the mountain-limestone, as the Productus and Orthis.

The carboniferous slate and lower limestone may be studied in the Dublin district, and the geologist should visit the carboniferous slate at Poulscadden, near Howth, and also a section near the martello tower at Portmarnock. The Old Red Conglomerate may be seen at Shenick Island, near Skerries, and the "*Posidonomya Becheri,*" a thin bivalve, strongly marked, may be obtained in the black carboniferous shales of Lough Shinny. We were informed by Mr. Kelly that, although he had searched the carboniferous slates in above 150 localities in Ireland, he had never found in them either the "Posidonomya" or the "*Pecten papyraceus,*" and that these mollusks are, therefore, characteristic of the shale beds *above* the slates. But, above all things, let us advise the stranger geologist to apply to the gentlemen connected with the Geological Survey and the Museum in St. Stephen's Green for information as to route, &c., before he visits *any* locality. It will save much time, trouble, and expense, and he will meet with true courtesy and attention.

Our route from Dublin to Dundalk lay through these carboniferous deposits, with patches of lower limestone, which, off the Skerry Isles, has been denuded from the Lower Silurian slates, and which, with the exception of the Drogheda district, occupy the route from the Skerry Isles, by Dundalk, to Newbliss. Drogheda deserves a halt for the purpose of studying the lower limestone and carboniferous slates. We were much interested, in travelling from Dundalk to Newbliss, in observing the "Escar-drift" of the Irish geologists, which rests in long ranges of gravel-hills along the sides of the valleys. The underlying rock consists of Silurian slates, and the overlying drift appears to have been deposited by quiet eddies.

The drifts of Ireland are divided by some geologists into:—1st. The Clay Drift. 2nd. The Great Drift. 3rd. The Escar Drift. The last is supposed to be the effect of eddies, as the land approached the surface.* Much of Ireland has evidently been submerged long after the "Boulder-drift" epoch; and the rounded hills of the "Escar-drift" being, to a certain extent, stratified gravels, must have been deposited by currents of water, and not by glaciers or floating bergs.

As we travelled from Newbliss to Enniskillen, our attention was directed to the remains of former lakes, which are now actually in the transition state, and turning into red bogs, of which kind the greatest portion of the bogs in Ireland consist. An able paper, by Mr. D. Moore, "On the plants, which, by their growth and decomposition, form the principal part of the Irish turf-bogs," read in section D, at the British Association meeting, has enlightened us on a subject of much difficulty.

Mr. Moore divides the varieties of bog into red bog, brown bog, black bog, and mountain-bog, and considers "the differences of colour and consistences of matter, of which each variety is composed, to depend chiefly on the localities where the substances are produced, according as they vary in different degrees of moisture, temperature, and altitude, whereby the growth and decomposition of vegetables are affected."

Red bog and brown bog are the least valuable for fuel, and "are supposed to have been formed on the sites of extensive ancient lakes or very wet morasses, which may be inferred from the very small quantity of wood mixed up." Sphagnums constituted a large portion of the substance of the peat, and the roots and branches of phanerogamic plants form a kind of framework, and bear up the cryptogamic species.

In the absence of all trustworthy experiments, "the rate of increase could not well be determined; but holes, out of which turf had been cut, had been observed to be filled up with soft vegetable matter to the depth of one foot in five years, and which, if compressed and solidified into one-fourth part of that bulk," would, Mr. Moore reckoned, "be as near an approach as can be made at the present day to the rate of increase of bogs."

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* See paper, by W. Birmingham. *Edin. New Phil. Journ.*, October, 1858, page 326.

The black bog contains much woody matter, and is believed to have been formed on the site of ancient forests, great quantities of the prostrate trunks of Scotch fir, oak, beech, alder, and yew being found with their roots *in situ.* The roots of the oaks are generally nearest the margin of the bogs, resting on the clay or marl bottoms, while the Scotch firs occur further towards the centre, and rest on several feet of peat, thus showing that a considerable accumulation of that substance must have taken place before they vegetated on it. A few of the trees of those ancient forests, which once covered a large portion of Ireland, still exist on the property of the Earl of Arran.

The mountain-bog is often found at the elevation of 2,000 feet, and in this variety, the grey moss, *Racomitrium lamiginosum,* supplies the place of the Sphagnum. On passing the residence of the Earl of Belmore, we saw, for the first time, beautiful timber, and a well-kept domain. Between Dublin and Enniskillen scarcely a tree is larger than the thistles in the gardens and corn-fields, and a fine oak tree is as great a novelty as a woman with shoes and stockings. The Windermere of Ireland, Lough Erne, separates at Enniskillen into the upper and lower lakes, the town being built upon an island connected by bridges with the main land. The country around is undulating, with bold escarpments of carboniferous limestone. The lower limestone forms the most extensive series of surface-rock in Ireland; but in the northern counties of Fermanagh, Cavan, Leitrim, and Roscommon, it is, in some districts, surmounted by the upper limestones of the series. The Calp series, which separates the limestones, appears to be exceedingly variable as to thickness, as on the north-west coast of Leitrim it exceeds 1,700 feet, while in the county of Cavan it is not more than 400 feet thick, and in the valley of the Barrow, at Carlow, is altogether absent; the upper limestone resting directly upon the black marble beds of the lower. Enniskillen is admirably situated for much condensed geology. At Lisbellaw, south of Enniskillen, the traveller may commence with marvellous conglomerates of the Old Red epoch; and proceeding by Florence Court and Culkeagh Mountain to Killargas or Riverstown, between Loch Gill and Loch Arrow, he may study every formation, from the rocks of the Old Red Sandstone to those of the coal-measure clays above the millstone-grit.

Florence Court, the seat of the Earl of Enniskillen, is situated on the Calp series, which we observed was cut into by several water-courses and drains. The mansion is handsome, and surrounded by noble trees; one avenue of the silver fir alone commanding the attention of the naturalist. The museum is an octagon room lighted from the roof, and contains, with the exception perhaps of Sir P. Egerton's, the finest private collection of fossil-fishes in Great Britain. On a platform in the centre there towers the perfect skeleton of the gigantic elk, *Megaceros Hibernicus,* and the walls are surrounded by glass-cases filled with the choicest fossils. We actually revelled among the remains of fossil-fish, from the pigmy teeth and spines of the Upper Silurian, to the stony yet fresh-looking specimens of the Tertiaries. But to none did we pay such especial attention as to the Ichthyolites of the Old Red Sandstone, very many of which were obtained from localities rendered classic by the pen of the lamented Hugh Miller. There were the stony relics of those long-dead organisms, with their delicate shadings, and "the dingy deep gray of the stone converted into light-buff, and on this ground, not very different from that which the limner would choose for a drawing in chalk, the fossils stand out in delicate azure, and varying in tint from a deep ultramarine to a light verditure." While, as we mused on the Coccosteus and Dipterus, the Cephalaspis and Glyptolepis, and those bituminous schists of Caithness, with "the colour as intensely black as that of the sealing-wax of a funeral letter, and turned over the pages of the work that describes these wonders in words so vivid and so true, we thought that 'Devonian' seemed scarcely the term to apply to those strata that have furnished those organisms and their history; while right glad are we to find that the chief of Siluria, in his new edition of his well-known work, still holds well and firmly, as regards the Scotch and Herefordshire districts, to the good old title of 'Old Red Sandstone.'"

The Calp of this district extends from Lough Erne to Bundoran, on the south-east coast of Donegal Bay; and in Belmore, near Enniskillen, and Ben Naglin, near Florence Court, it is surmounted by 600 feet of upper carboniferous limestone. There is an impure limestone of the Calp series, which in this district is highly fossiliferous and full of encrinital heads and stems, with large and perfect Producti, wheih benig white, stand out well on the black ground of the limestone. We visited the shores of a beautiful lake some three miles from Florence Court, and, on the banks of the stream flowing from the Marble Arch, might have filled a cart with choice carboniferous fossils of the Calp series. One patch on the shores of the Lough was covered with the lovely grass of the Parnassus (*Parnassia palustris*), with its delicate cream-coloured flowers fringed with white nectaries. This Lough is famous for the fresh-water Astacus (or cray-fish), which grows here to a large size. The heron rose lazily upon our approach, and groups of wild duck floated upon the waters. We made an expedition to the upper limestone district of Ben Naglin, west of Florence Court, and took the opportunity of visiting one of the two original Florence Court yews in the garden of a descendant of the discoverer, a tenant of the Earl of Enniskillen. The sister tree is at Florence Court, and from these have been propagated the now widely-cultivated Irish yew. This tree is a *hybrid*, but how the hybridity was brought about is still a mystery. The old trees were found as dwarfling plants, by the farmer who discovered them, on the very summit of Kulkeagh, a mountain of milstone-grit that covers up the upper limestone of Ben Naglin. We have no representation in our western districts of England either of the calp or the upper limestone series, so we would advise every geologist to pay attention to their development in the North of Ireland; and, if time allows, to trace the rocks from Knockshinny, on the west shore of Loch Erne, to Benbulben and Sligo. In the north of England (Yorkshire and Durham), these Irish limestones are represented by the Great Scaur series. The limestone of Ben Naglin supplies the collector of fossils with the somewhat rare *Pentremites ovalis*, an echinodermatous animal of the Blastoidea family, and shaped like a minute sea-urchin; and the Tunbridge fern "*Hymenophyllum Tunbridgense*," grows upon the summit of the hill. A wild scene of heathery moor and moss stretches westward from the hill-top towards the coast.

The traveller would do well to ascend Kulkeagh by the way of the Marble Arch, where a fine wild dell is wrought by the rivulet which flows from the mountain to the lake. The Marble Arch is a subterranean cavern with the roof fallen in, and with wood, rocks, and gushing water, forms a highly picturesque and pleasant scene. Nearer Kulkeagh is another cavern, where one of our attendants informed us he had often distilled "potheen," and fried black trout and praties "far from the light and the exciseman." Goniatites, Posidonomyæ, and beautiful corals may be obtained by following the banks of the streams that flow from a small lake beneath the escarpment of Kulkeagh, and which we traced through the moors; and for sections or fossils we cannot recommend this route too highly.

The coal-measures are miserable representatives, as regards that precious mineral, of our English equivalents, and probably have been much denuded. Coal-plants are abundant with marine fossils, such as *Bellerophon* and *Pecten papyraceus*, but I think that the Irish series of coal-measures are no more than the millstone-grit (Rosser seams) of the South Wales basin; the true coal-series being altogether absent. Ballycastle, Dungannon, and Coal Island are the localities whereat to study these coal-measures. For the northward-bound traveller our note-book furnishes the following localities, from the information given us by Mr. John Kelly, for unconformable junctions of Old Red conglomerate (or its equivalent) with mica-slates; these mica-slates being most probably altered Lower Silurians of the Lingula or Llandeilo age:—Sligo, Lugnaduffa, seven miles west of Ballysadare, and Clonacool, thirteen miles west of Cooloony. At Bundoran, three miles west of Ballyshannon, is a very peculiar section, the Old Red being cut off by a fault, and the Calp wanting. Donegal, Ballykillowen, eleven miles north east of Ballyshannon, and Cormullin, eight miles north-east, furnish excellent sections.

We returned to Dublin, *via* Cavan and Mullingar, a most uninteresting route, but well worth seeing once in one's life, were it merely to gain an idea of a true bog-country. Kilnaleck, south of Cavan, and near Loch Sheelin, is interesting as furnishing Lower Silurian anthracitic coal, first discovered by Mr. J. Kelly. This is a very important rock, and will probably occupy the attention of geologists very particularly, in order to determine the character and status of the plants that formed so old a coal-seam. Were they merely marine fucoids and sea-wrack, sea-weeds of primeval oceans? or were they land-plants that bent to the breeze and ripened to the sun of ages so distant that time furnishes no reckoning-log? *Videbimus!*

ON MERCURY IN ALLUVIAL DEPOSITS.

By Dr. J. J. W. Watson, F.G.S.

Dr. Phipson, of Paris, has drawn attention, in the April number of the Geologist, to the observations which have been made of the presence of mercury in the soil and substrata of the town of Montpellier, and, in your June number, another correspondent notices the finding of the same metal under circumstances so decidedly adventitious, however, as to possess, I think, rather archæological than geological interest. The occurrence of this precious metal in rocks and mineral deposits of such ages as we should hesitate to assign for its matrix, most probably arises from its fluid nature admitting of its easy transport to distances far remote from those formations in which it exists *in situ;* and, as furnishing something like the history of its presence in such apparently abnormal situations, the following account of its discovery at Ajaccio, in the Island of Corsica, may, perhaps, be considered worthy of insertion:—

In the year 1811, a M. Matthieu, an Engineer Officer of the French Army, was entrusted by Napoleon with the mineral survey of the Island, but, being re-called to his military duties in 1814, was cut off before Leipzig, leaving in the possession of his widow the notes he had made of his survey. These notes do not appear ever to have been officially communicated, but among them was a memorandum to the effect that a deposit of mercury existed at Ajaccio. In 1847, a sewer was in course of construction near the barracks of the gendarmerie, at the Place Mourou; and, in trenching below the vegetable soil, a large quantity of metallic mercury was found disseminated through the earth in minute globules—it is calculated that about 270 cart-loads of this mercuriferous soil were removed. Owing, however, to the persons engaged in making the drain being ignorant of its value, but a very small quantity of the metal was preserved, and, beyond the ordinary curiosity which such an occurrence would excite, the circumstance does not seem to have met with any attention until 1850, when a fresh quantity was discovered in digging the foundation of some houses in the Place Mourou, at a distance of about 500 yards from the locality where it was first found. This time attention was roused, and the existence of an important deposit capable of being profitably exploited became a subject of speculation. Accordingly, the drain near the barracks of the gendarmerie was opened, but no traces were then discovered of the precious metal, and the subject again became a matter of tradition. In 1855 a company, having for its object the industrial development of Corsica, was formed in Paris under the comprehensive title of "Compagnie Minière, Industrielle et Agricole de la Corse," its principle object, as set forth in the prospectus, being the search for a mine of mercury. The operations of this company commenced in the following year, and were followed out in a manner certainly novel, as far as regards ordinary methods of mine-exploring, but, as far as getting to see things geologically, on certainly the best plan that could have been pursued. On my arrival at Ajaccio in the summer of 1856, I found that M. Aqui, the gérant of the aforesaid company, had opened a rude description of quarry in three floors near to the spot where the mercury is stated to have been found in digging the foundation of the houses in the Place Mourou. The quarry was placed by the side of a low hill, and the uppermost floor consisted merely of the rock bared by the removal of the soil; the middle and lowermost floors were worked in the rock itself, the latter being approached by a drift driven across the rise of the hill from the level of the road from the barracks to the sea: the direction of this drift was parallel with the drain before-mentioned. I found the "shelf," thus exposed, to be a white granite, the felspar (both orthoclase and albite) being rather in excess of the other constituents. The rock was somewhat stained with oxide of iron, and contained patches, or rather little nests, of chlorite in the horizontal divisional planes, which inclined steadily towards the sea: the transverse vertical joints ran north-east and south-west. To describe all the points, lithological and petrological, in connection with this granite would take up too much space and be beside my object, but the following peculiarities may be enumerated:—1st. The occurrence of little lenticular patches of crystallized arsenical iron-pyrites, apparently in the heart of the rock, but really placed on the sides of the vertical divisional planes. 2nd. Kidney-shaped nodules, having a radiated structure (called by the workmen "rognons") of the same mineral, reposing in little hollows in the horizontal joints, and on the surface of the rock immediately below the soil. 3rd. Drusy cavities, lined with a black meagre mineral, which greatly resembled carbonaceous matter, but which I ascertained to be mica in very minute laminæ, and 4th, Thin beds near the intersections of the joints, of a soft whitish clay, or impure description of kaolin. The occurrence of the two last-named minerals in the granite, in the manner described, is nothing more than we should expect to find in an ordinary rock of the kind; but, in connection with the presence of the arsenical pyrites, their occurrence is interesting, as indicating an aqueo-chemical origin, and pointing to changes having taken place, such as might be favourable to the existence of, to use a mining phrase, a mineral-bearing condition of the ground. This view was supported by my being able to procure small specimens of cinnabar from three little strings (they were not of a magnitude to be called veins) of quartz, which ran south-west, and were traceable throughout the whole lateral breadth of the quarry, being, no doubt, continued under the adjoining covered rock. Small and insignificant as they were, the largest being less than six inches wide, they possessed a regular vein-stone, and had many of the true characters common to mineral veins.

As a rule, I believe metallic mercury is always associated with cinnabar, and its distribution is nearly confined to rocks of the palæozoic or *oldest* mesozoic ages. But it has also been found in talcose-slate in Hungary, and, according to Dana, sparingly in granite; and these, with the foregoing, are probably the only rocks in which either mercury or its ores ever really exists *in situ*, although it is quite possible that there may be localities where even the newest formations of the mesozoic age may have undergone such changes by contact with igneous rocks as to have become mineralised with this metal. Without, then, indulging, in consequence of the facts above related, in any vaticination for the discovery hereafter of important mines of mercury in the neighbourhood of Ajaccio, the presence of the cinnabar in the granite at that place, so near to the place where the metal was discovered in the soil, is interesting, because it at once suggests the origin of the deposit, and supplies a rock of such a character as would be likely to contain a mercuriferous gangue or matrix; and, referring to the known erratic origin of metalliferous deposits, there is no difficulty whatever, in the case in point, in accounting for the existence of the mercury in the alluvium on the supposition that, with the progress of chemical decompositions in the granite, such as those which were concerned in the formation of the kaolin, a joint connected with that portion of the rock containing the metal, either in a regular vein or otherwise, may have been gradually enlarged and converted into a fissure, giving exit to the metal, which would, besides undergoing rapid transport by water and its own gravity, be quickly disseminated through the porous vegetable soil by capillary attraction. Adopting this causation, I see no reason why the mercury in Tertiary sands, as noticed by the late Mr. Sharpe, in Portugal, or in the fissures of the calcareous conglomerate at Montpellier, or even the Lombardian deposit (Cividale), should not be considered as derived from adjacent formations of, if I may use the expression, a more congenial antiquity. It would be well if those who have observed this metal in recent deposits would extend their examination to neighbouring rocks (supposing such to exist) of an older date; and there would scarcely be, I conceive, a more interesting, or certainly more practically useful, branch of physical geology than would result from a gathering and arrangement of the facts relating to the age of metalliferous deposits, and the distinguishing of those rocks to which they are specially restricted for their matrix, from those in which they have become reintegrated, as it were, after being transported from other formations.

CATALOGUE OF THE GOVERNMENT SURVEY MAPS AND SECTIONS.

(*Continued from page* 345.)

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19	Mendip Hills. Somerset Coal Fields. Oolitic and Chalk deposits. 6s. Hor. Sect., sheets 14, 15, 16, 17, 20, 21, 22. Vert. Sect., sheets 11, 12.
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21 Devonian of the S. of Dulverton and Wiveliscombe. Coal Measures. New Red Sandstone, with its Dolomitic Conglomerate, and Igneous Rocks near Crediton and Silverton. Inferior Oolite. Lias. Upper Greensand. Chalk. 6s.
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Hor. Sect., sheets 12, 14, 15, 17. Vert. Sect., sheets 7, 11, 12.

36 Part of Monmouth and Glamorgan Coal Field. Outcrops of the Coal Beds, Faults, &c. Silurian. Old Red Sandstone. Carboniferous Limestone. New Red and Lias Deposits. 6s.
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41 Carmarthen Coal Field. Carboniferous Limestone. Old Red Sandstone. Silurian. 6s.
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42 N.E. Old Red Sandstone. 2s. 6d.
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56 S.E. Silurian Shales. Sandstones. Trap Rocks. Limestones. Old Red Sandstones. 2s. 6d.
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57 S.W. Lower Silurian. 2s. 6d.

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58 Lower Silurian. 3s.
Hor. Sect., sheet 4.

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59 S.E. Mineral lodes. Lower Silurian. 2s. 6d.

60 N.W. Lower Silurian or Bala Beds. Lead and lodes. 2s. 6d.
Hor. Sect., sheets 26, 29, 32.

60 N.E. Lower Silurian or Bala Beds. Igneous Rocks of Breiddens, &c. Upper Silurian Shales and Sandstones. Old Red Sandstone. Shropshire Coal Field. Permian Rocks. New Red Sandstone. 2s. 6d.
Hor. Sect., sheets 32, 33, 34, 35, 36, 38.

60 S.W. Silurian Shales. Sandstones. Slaty Beds. Lead and lodes. 2s. 6d.
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61 N.W. Silurian Sandstone. Shale. Shropshire Coal Field. Permian. New Red Sandstone. 2s. 6d.

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63 N.E. Lias. New Red Marl. Sandstone (Keuper). Gypsum. Cambrian Rocks of Charnwood Forest. Igneous Rocks. Greenstone. Syenite. Granite of Mnt.Sorrell. 2s.6d.

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Hor. Sect., sheet 18.

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FOREIGN CORRESPONDENCE.

BY DR. T. L. PHIPSON, OF PARIS.

Sketch of the Geology of the Coast of Flanders—Discovery of a recently-formed Rock near this Coast—Fresh-water Limestone and Marine Tufa—New observations on the Metamorphism of Sedimentary Strata—Curious experiments by M. Ch. Deville—Artificial transformation of Chalk into Dolomite—Signification of the presence of Sulphates in Dolomites—Discovery of soluble Chlorides in these rocks—Experiments on Clays and Sandstone—Hydrophane: its artificial production and analysis by M. Langlois.

MANY curious facts render the coast of Flanders very interesting in a geological point of view. Such, for instance, are—1st, the slow oscillation of this district, first noticed by Belpaire, and which still continues;* 2nd, the progressive movement of the sand-hills (dunes) towards the interior of the Belgian continent; 3rd, the existence along this coast of an immense bed of grey clay or marl, which spreads from the river Scheld to Calais, and which has been formed at a comparatively recent period, according to some geologists, since the time of Julius Cæsar. To these and some other curious particulars we hope to refer again. At present we have to speak of a peculiar rock which we laid before the Academy of Sciences at Paris, a short time ago, and which appears to be daily forming on the coast of West Flanders.

The littoral portion of West Flanders presents three distinct stratifications, which have been classed by Omalius d'Halloy, in his "Terrains Modernes," and necessarily belong to some of the most recent geological formations. Beginning with the uppermost strata, we have—1st, the sand of the coast, and of the sand-hills or "dunes;" 2nd, a bed of grey clay or marl, generally known as the "Argile grise d'Ostende" (because it is very well developed in that neighbourhood), which attains, in some places, a thickness of from three to eight feet or more; 3rd, a bed of peat, which lies upon the sand known as "Sable de la Campine" (the whole of the province of la Campine being covered with it). These beds of clay and peat pass under the sand-hills of the coast, and extend to a considerable distance into the sea.

The recently-formed rock to which I allude in this paper appears to have been deposited, and continues in all probability to form daily, at or near the extremity of the stratum of peat, more than six miles from the coast.† When the weather is stormy, the sea throws up large blocks, enveloping fragments of peat, and the shells of mollusca which live in the present sea. The most common of these shells is that of the cockle (*Cardium edule*), seen also, as a fossil, in the *argile grise*, on which the corn and potatos grow so well in the neighbourhood of Ostend; but the rock contains an infinity of others, all common on the coast or in the neighbouring sea.

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* We have already noticed this in the pages of the GEOLOGIST (January, 1858).—T. L. P.

† About six miles out at sea, and stretching along the coast from Blankenberg to Ostend (a distance of about ten English miles), exists a bank or bar, called by fishermen "The Black Bank," which is the most dangerous on the coast. There are also many sand banks, which shift their places according to the weather, the currents, &c. The bank we allude to here is, however, nothing less than the peat and clay beds mentioned in the text as stretching out into the sea underneath the sand of the coast. It consist principally of peat, of which large fragments, often pierced by innumerable *Pholas dactylus*, &c., are constantly thrown upon the coast in rough weather. The anchors of ships will not hold in it; and at low water it is covered with only three feet of water.—T. L. P.

Upon submitting this rock to a careful examination, I found it to be a tufaceous limestone, of a grey colour, containing a considerable admixture of clay and sand, some few lamellæ of mica, vegetable débris of peat, and recent shells. Some fragments of it are light and fragile; others, harder and denser, consist of layers superposed in such a manner as to show that they have been formed successively, but which do not obliterate the compact appearance of the larger masses. This structure is frequent in tufaceous limestones.

On examining the *argile grise* which exists all along the coast of Flanders, I found that it is in reality an argillaceous marl, producing effervescence in acids, and containing a notable proportion of carbonate of lime (at least on the coast of Ostend); so that the tufaceous rock in question may owe its existence to a gradual absorption of carbonate of lime by this argillaceous stratum; but it is, no doubt, to the cretaceous rocks which are bathed by the waters of the English Channel (such as the chalk cliffs of Dover, &c.), that the carbonate of lime in our recent rock is owing.*

Fresh-water tufa, or travertine, as it is sometimes called, is very common in limestone countries, as all our readers are doubtless aware—there is hardly a stream in such districts but deposits carbonate of lime by the loss of the carbonic acid in the water which held it in solution. Marine tufa, however, has been looked upon, perhaps erroneously, as of much rarer occurrence. It has been observed in Sicily, at the Island of Ascension, in Australia, &c. Every one has heard of the famous rock discovered in the Antilles by M. Moreau de Jonès,† and which the negros have christened *maconne-bon-Dieu*. It became celebrated from being found in Guadaloupe to contain human bones. Another such formation was observed by de Saussure* in the Straights of Messina; and M. de Boblaye† has described a similar rock which he found on the coast of Australia. Finally, deposits of marine tufa have been noticed in recent times at certain points of the English coast.

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* Since I found this marine tufa on the coast of Ostend, I have seen, in the geological collection of the *Jardine des Plants*, at Paris, a rock called "Grès coquillier de Beauchamp (Seine et Oise)," containing both marine and fresh-water shells, and which appears to me to be identical with the tufa described in the text above.—T. L. P.

† *Hist. Physique des Antilles;* also Humboldt *Relation Historique.*—T. L. P.

Whilst noticing rocks of modern formation, we should bear in mind the curious Oolitic limestone deposit which is being effected at the present time in the great lakes of Mexico, and the modern Oolite discovered by Leop. von Buch, in the Canary Islands.‡

M. Ch. Sainte Claire Deville, recently elected member of the Academy of Sciences, at Paris, has just read before that institution a long memoir on the action of the chlorides and sulphates of alkalies and earths in the metamorphism of sedimentary strata. Following in the path trodden by Sir James Hall, Dulong, Haidinger, Marignac, Daubrée, and others, the author has added one or two new features to the interesting series of investigations already made on metamorphism. Metamorphic phenomena have been so frequent on the surface of the globe, that although rocks may have been wonderfully changed by it in aspect and chemical composition, the processes by which these changes have been produced must nevertheless, thinks M. Ch. Deville, have been characterized by a certain simplicity; the chemical re-actions, of which we see the results, must have taken place between bodies which are abundant in the crust of the earth. By his researches on the gaseous emanations observed in volcanos, salzes, hot-springs, &c., the author has been led to conclude that the four elementary bodies, carbon, chlorine, sulphur, and fluorine, predominate in the chemical phenomena of the globe; and that they or their compounds must have played a great part in the metamorphism of rocks. From their action on sedimentary strata, says he, have arisen—1st, insoluble substances, as the minerals observed to have been formed in strata which have undergone metamorphism, and in which the carbon is seen to have been almost wholly fixed in the state of carbonates, the sulphur mostly as sulphates and sulphides, some traces of chlorine only, as chlorides, and nearly the whole of the fluorine, as fluor-spar, and certain fluo-salts; ‖ 2nd, soluble salts, containing nearly the whole of the chlorine, a good deal of the sulphur, and a small proportion of the carbon. This is exemplified in the composition of sea-water, for the salts it contains it has obtained whilst filtering through the strata of the earth.

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* *Voyage dans les Alpes.*—T. L. P.

† And likewise Perron (see Beudant, *Geologie*).—T. L. P.

‡ See the GEOLOGIST for February, 1858, p. 72 et say.—T. L. P.

‖ Topaz contains mica, &c.—T. L. P.

It was the action of these soluble salts upon the three categories of sedimentary strata, that the author deemed it necessary to investigate.

The following results have been obtained :—

Limestones.—Many experimentalists,* acting upon ideas enunciated by Leop. von Buch, that dolomite resulted from the substitution of one equivalent of magnesia for one equivalent of lime, in limestones, have obtained a mixture containing magnesia and lime, in the proportion of dolomite, by heating to 200° (centigrade), and at a pressure of 15 atmospheres, carbonate of lime with sulphate of magnesia or chloride of magnesium. M. Ch. Deville has shown that the same re-action can take place at 100° (centigrade)—boiling-water point—and at the ordinary pressure of the atmosphere. He steeped a fragment of chalk in a solution of chloride of magnesium, until it had absorbed as much as possible of the liquid, and then heated it to 100° in a crucible. He observed what Dulong, when studying the action of soluble salts upon insoluble ones, had remarked before, namely, that the re-action takes place, but is very limited. Thus, by one operation, six or seven per cent. of lime only is replaced by magnesia. But, if the piece of chalk be washed so as to eliminate the chloride of calcium formed, steeped again into the chloride of magnesium, and a second operation effected, more lime is replaced by magnesia; and, after the eighth experiment, the two bases are in the proportion 1 : 2 or 1 : 1·5, that is, as they are found in dolomite.

What takes place in these experiments may be clearly seen by the following formula :—

Insoluble.		Soluble.		Insoluble.		Soluble.
$2\,\dot{Ca}\,\ddot{C}$	+	$Mg\,Cl$	=	$(\dot{Ca}\,\ddot{C} + \dot{Mg}\,\ddot{C})$	+	$Ca\,Cl$
2 equiv. of Carb. Lime	+	Chloride of Magnesium.	=	Dolomite.	+	Chloride of Calcium.

Fragments of coral, &c., were treated in the same manner, and transformed into dolomite (after a succession of imbibitions with chloride of magnesium and calcination to 100° C), without losing their organic structure or their external appearance. These experiments call to mind the influence of long persistent chemical actions in nature, which we have already noticed before. If the anticipations of Leopold Von Buch are exact, says M. Ch. Deville—if really dolomite has been formed in nature by the substitution of one equivalent of magnesia for one equivalent of lime, in limestone—the magnesia having been brought in one form or another from the interior, one ought to find in the transformed rock traces of the substances that have occasioned the transformation. In the memoir referred to this is proved to be the case. A great number of dolomites, as is well known, are found in nature associated with anhydrite or gypsum, and these are sometimes intimately mixed, as we find, for instance, in the dolomite of l'Ariège, in France. M. Hugard has recently shown that sulphate of baryta is mixed up with the dolomites in the Valley of Binn, and that this salt appears to be nothing less than the traces of the sulphuretted agents which have determined the formation of these dolomites.

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* Haidinger, de Morlot, Marignac, Durocher, &c.—T. L. P.

M. Ch. Deville has proved satisfactorily to himself that *chlorides*, notwithstanding their solubility in water, which accounts for their being rarer in rocks, more frequent in the waters of the ocean and rivers than sulphates, *are, nevertheless, to be found in dolomites*, in such quantity (more than the 1-1000th part of the rock) as may be determined by careful chemical analysis. The author assures us that he has found chlorides in dolomites from the Valley of Fassa,* especially in those from Rosengarten, and, again, in the dolomites of Seefeld, in the Tyrol, in those of the variegated marls of Fribourg, in dolomites from the carboniferous strata in the province of Liège (Belgium), and, finally, in the Tertiary dolomite of Beyne. When treated with pure water, at boiling point, these rocks yield chlorides of calcium and magnesium. Others, such as the dolomite of St. Gothard, have never shown traces of either sulphates or chlorides, which singular fact tends to prove that, in the manufacture of dolomites, nature has evidently employed more than one process.

Clays.—The author's experiments on clays are similar to those described above. Taking a fragment of pure kaolin,† he soaks it in a solution of common salt (chloride of sodium) and, after having slightly dried it, heats it to a good red heat in a platinum crucible. Soon vapours of hydro-chloride acid are given off (showing that the salt is decomposed) and silicate of soda is found to have formed in the kaolin. This experiment is repeated three, four, or five times, until the kaolin no longer decomposes the salt, when the earth is seen to have become a granular mass of crystals, easily fusible, and so hard as to scratch glass with facility. The same experiment was tried with chloride of calcium and chloride of magnesium instead of salt, and with similar results. Chloride of magnesium and proto-chloride of iron act with far greater ease than common salt. But, as a remarkable exception, chloride of potasium gives no result at all. This becomes an extremely interesting fact, since M. Delesse has shown formerly that those feldspars, which seem to have been produced by metamorphism, are never found to contain potassa.

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* We should remember that a well-known English *savant*, Dr. Percy, formerly suggested that the circumstance of the production of *Gehlenite*, at a high temperature, in an iron furnace, may possibly be available by geologists in explaining the formation of the rocks in which the natural mineral occurs, as in the Valley of Fassa (or Fassathal) in the Tyrol, mentioned here.—T. L. P.

† Silicate of Alumina.—T. L. P.

Sandstones.—One experiment is alone recorded :—The author took a piece of sandstone, essentially quartzose, and containing little or no admixture whatever—it was the *grès d'Orsay*, with which the streets of Paris are paved. He soaked it alternately with a solution of chloride of magnesium and a solution of chloride of calcium, and then submitted it to a red heat. After a certain number of successive imbibitions and calcinations, the sandstone was observed to become spungy ; it absorbed, without difficulty, a considerable quantity of liquid, and was easily pulverized in an agate-mortar. Thus pulverized, it was heated in a crucible to a white heat, when it melted, and was transformed into a milky mass, composed of numerous long crystalline needles. It had a specific gravity of 3·00, was insoluble in acids, and did not contain a trace of chlorine. When analyzed, it gave the composition of amphibolite or pyroxene, of which it showed the specific gravity.

Hydrophane is opal (hydrated silica), which has the remarkable property of becoming transparent or translucid when placed in water, and losing its transparence again when taken out of the liquid. M. Langlois* has just produced artificial hydrophane in the following manner:—A current of chloride of silicium is brought through a tube, terminating by a glass funnel, the wide opening of which just touches the surface of water. The chloride of silicium is decomposed in presence of water, even before it comes in contact with the liquid, in the damp air contained in the funnel, and hydrophane is deposited upon the sides of the latter. It is translucid when wet, opaque when dry, and becomes translucid again whenever it is placed in contact with water. Analyzed, it gave a formation similar to that of resinite:—

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* We remember having read in the *Comptes Rendus*, of the Paris Academy of Sciences, a memoir published many years ago by Ebelman, late chemist of the porcelain manufactory of Sèvres, where he describes a process by which he produced hyalite ; and, if we are not mistaken, hydrophane also. We will turn again to this memoir at the first opportunity.—T. L. P.

$$(Si\,O^2)^3,\ 2\,H\,O$$

or, water 11·68; silicic acid, 88·32.

NOTES AND QUERIES.

POTATO DISEASE.—"The early re-appearance, this season, of the potato disease in the Midland Counties, induces me to call the attention of practical geologists to the subject; for perhaps I may not err in supposing that soil exercises great influence in the development of the disease. In the year 1855, when travelling from this place to Penman Mawr, I was forcibly struck by the fact, that whilst all the potato fields in the district occupied by the varieties of the New Red Sandstone, through which my course lay, exhibited unmistakeable signs of this disease, no sooner were the older strata, whether carboniferous or Silurian, entered upon, than all the potato crops presented a perfectly healthy appearance. Again, in the autumn of last year, all the potato crops in this region suffered in a greater or less degree; whilst, as I was informed by an eye-witness, in the carboniferous and other strata of Northumberland and Cumberland, the potato crops were wholly free from this disease, although the weather in that part of England was so wet and ungenial at the time, that the crops of corn suffered greatly from excess of moisture. It has occurred to me as by no means improbable that, by a proper admixture of soil, this serious evil might, in a great measure, be suppressed, if not wholly eradicated; and, if agricultural geologists would, through the medium of the GEOLOGIST, furnish reports of the districts in which the disease is particularly prevalent, and of those where the crops are healthy, it might lead to very beneficial results.—R. M. ZORNLIN, Kenilworth, August, 1858."

CLASSIFICATION OF THE PURBECK BEDS.—"SIR,—As a student of geology, I have been much puzzled with the classification of the Purbeck beds; some authors representing them as belonging to the Wealden, others to the Oolite, and some again as being a distinct formation. Can you inform me, through your invaluable Journal, which is most correct. Also, of the origin of the popular belief in the existence of coal beneath Blackheath, near London.—Yours obediently, N. Z. FOSSIL."—The Purbeck and Wealden deposits are probably contemporaneous with certain lower Cretaceous marine beds, which are to be found existing in France and Switzerland, and were, therefore, anterior in age to our greensand and chalk, though to some extent our lower greensand intercalates with the Upper Wealden beds. The rivers of the Oolitic, Wealden, and early Cretaceous period evidently ran from the same lands, though these were progressively modified in extent, and washed by seas, holding, as ages advanced, successively modified faunas. In geological language, therefore, the Purbeck and Wealden indicate a transitional period between the Jurassic and the Cretaceous periods, partaking in the animal and vegetable characters of each.

QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY.—The following circular has been issued by the Society to the Fellows :—SIR.—We are directed by the Council of the Geological Society of London to transmit to you, as a Fellow thereof, the following statement in regard to the Quarterly Journal of the Society, and to request your aid in making the value of this publication more generally known and appreciated, in the expectation that thus a larger number of copies may be regularly circulated among subscribers. If this can be accomplished, the Council will be enabled not only to maintain the Journal in the high state of efficiency which it has acquired, and even to increase its utility, but also to entertain the question whether to reduce its price to Fellows of the Society. The Journal of the Geological Society, published regularly four times in the year, contains corrected memoirs and abstracts of communications made to the ordinary meetings; carefully executed engravings of organic remains, diagrams, and sections, are frequently given to illustrate the papers, and selections from foreign journals and publications place before the reader a general amount of contemporary geological progress. The authors whose labours are preserved in the Journal comprise the most eminent cultivators of British Geology : the papers which they have contributed record almost every recent discovery of importance, in descriptions mostly drawn up by eye-witnesses ; the subjects treated of include all classes of facts in the domain of positive geology and palæontology. By receiving this prompt and complete account of the labours of the Geological Society, the Fellows, even when unable to be present at the meetings, are furnished with a guide to the progress of Geology at once full and trustworthy, We doubt not that these considerations will have their due weight on your mind, and induce you to give effect to the wish of the Council by instructing us to enter your name on the list of subscribers to the Journal (if it be not so entered already), and by recommending it to the favourable attention of your friends. The annual subscription of a Fellow of the Society, wishing to receive the Journal regularly, is *Twelve Shillings*, due at the commencement of each year. The payment can be made either to the collector, or to Mr. Charles Nichols, at the apartments of the Society, or by post-office order, addressed to Mr. Charles Nichols. The numbers as published are delivered at any address in London ; or they can be sent by post to any Fellow of the Society, on the payment of *Thirteen Shillings* annually. The public are supplied through the ordinary channels of trade, by Messrs. Longman and Co., at *Sixteen Shillings*.—We have the honour to be, your very obedient servants,

JOHN PHILLIPS, President,
WARRINGTON W. SMYTH, } Secretaries.
THOS. DAVIDSON, }

Few works of a scientific character are so well managed or so creditably produced as the *Journal of the London Geological Society*. For importance of information, for originality of material, for purity of diction, and for editorial care, it ranks among the first journals in Europe ; but we think the Council will err in reducing the price. The matter is now well worth the money charged, and works of a purely scientific character stand in a different position altogether to those of a popular character. There are only a definite number of really scientific men or readers in the world, and no amount of cheapness in a periodical will increase that number, but cheapness in the popular or elementary work increases its circulation amongst the great mass of society. All true geologists either take, or ought to take, the Quarterly Journal, and we agree entirely with every effort that will not leave out any geologist from the number of the subscribers ; but we do not think that any amount of cheapness would increase its circulation among the mass, while the reduction of the price, with a limited issue, must necessarily deteriorate the quality of the book.

CEPHALASPIS.—"Will you kindly inform me where I can see a late paper of Prof. Page's, entitled, 'Contributions towards the restoration of the Cephalaspis and its kindred ?'—G. R."

AMATEUR GEOLOGISTS' ASSOCIATION.—The Editor of the GEOLOGIST has received letters for Mr. Heyward, but cannot forward them, not knowing that gentleman's address.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

OSWESTRY NATURALISTS' FIELD CLUB.

On Thursday last, the 29th July, the members and friends of the above society made their third excursion for this season. The "field" to be explored was a very interesting one, embracing the coal-measures and millstone-grit of Sweeney and Treflach, and the mountain-limestone of Treflach and Trefonen, terminating with the Moelydd.

The members present were:—Mr. J. Meredith, Oswestry; Rev. D. P. Lewis, Buttington; Rev. F. W. Parker, Welshpool; Rev. J. E. Hill, Welshpool; Rev. D. Lloyd, Trefonen; Mr. S. W. Williams, Welshpool; Mr. D. C. Davies, Mr. E. W. Thomas, Mr. S. S. Lees, and Mr. J. Croxon, Oswestry; Mr. J. Clarke, Brookhouse; and Mr I. F. Whitridge, Morda. The following gentlemen also attended as visitors.—Mr. J. S. Davies and Mr. Turner, Oswestry; Mr. Hughes, King's College, London; and Mr. Stokes, Trefonen.

The party proceeded by Sweeney Colliery and Gronwen to the locality between Treflach Hall and Sweeney Mountain, where some of the members were interested in observing the line of faults with which the millstone-grit is broken, those faults being there distinctly traceable along the surface. Others commenced a search for the rare fern, *Hymenophyllum*, said to grow in a wood thereabouts, but were unsuccessful. From thence they wended their way to the quarries in the mountain-limestone at Treflach, where the collectors of fossils soon filled their bags and boxes with the various genera of corals, shells, &c., peculiar to that formation. Among others, we noticed a very perfect tooth of Megalichthys. From Treflach the excursionists proceeded in two parties to the Moelydd. The one ascended the hill by the direct route, the other from its base at Nant Mawr, in order to make out the nature and position of the rocks of which the hill is formed. Here again they were rewarded by finding numerous specimens of fossil corals and bivalve shells in the blue shale underlying the mountain-limestone. The gem of all the fossils found during the day, however, was a very perfect specimen of a trilobite found in the blue shale just mentioned, by the Rev. D. P. Lewis, of Buttington. From this shale the members ascended to the igneous rock which flanks the western side of the hill, and having obtained numerous crystals of sulphate of iron, with which that rock is plentifully dotted, they started for the top of the hill, where, in a happy oblivion of tables and chairs, they proceeded to discuss, with a right good will, the bountiful repast laid out on the green sward for them by Mrs. Hughes, of Yr Efel Inn.

The Rev. F. W. Parker said he was sure it was the feeling of all present, that the meeting ought not to separate without expressing their respect to Mr. Meredith for the deep interest he had taken in the welfare of the Society, and the kindness with which he had assisted the members on the several excursions. He hoped that success and prosperity might attend him in his far-distant home.

Mr. Meredith replied that, when far away, nothing would give him greater pleasure than to know that this Society was doing its best to work out what he had begun—the geology of the district—and he hoped that he should hear from some of the members; and if ever he returned to England, his first desire would be to visit the Oswestry Naturalists' Field Club.

Mr. D. C. Davies proposed that Mr. Meredith should allow his name to be placed on the list of honorary members of the Society, as no one was more worthy of that honour than he was.

REVIEWS.

Report of the Twenty-seventh Meeting of the British Association for the Advancement of Science; held at Dublin, in August and September, 1857. *London: John Murray, Albermarle-street*, 1858.

The Report of the British Association Meeting for 1857 has just appeared and is as usual, a most valuable and interesting volume; although most of the important portions were long since made public by the various newspapers and the periodicals at the time of the meeting, and the report itself appears somewhat wanting in novelty, like the detailed dispatches following long after the rapid information of the telegraph. To review it at length would require more space than we could afford, but it would not be granting it more than its deserts; we shall, however, content ourselves with noticing more particularly the geological portions. The report on the Temperature of some deep Mines in Cornwall, by Mr. Robert Were Fox, is an addition to the evidences on an obscure, but highly interesting, point. The "bearing" of the Cornish metalliferous lodes is generally and ordinarily from northward of east to southward of west, and they commonly descend into the earth to unknown depths in an inclined direction; the working of the lodes being effected by means of shafts and galleries or *levels*. The water is pumped up the engine shaft, from the bottom or *sump*, up to the adit, from which it is discharged into a valley or near the sea-shore.

The *cross-cuts*, or north and south levels, connect the engine-shaft with the levels at right angles to them. These latter, or the course of the lode, are usually about ten fathoms apart, and are connected together by many short shafts inclined into the lode. There are also other shafts from the surface to the deep levels, through which the ore is drawn up, and the ventilation of the mine effected In most of the deep mines several lodes are simultaneously worked, each by a similar series of shafts, levels, &c., which are connected with the former series by *cross-cuts*, so that one engine may serve for two or more lodes. The deepest levels in a mine are generally much less extended than those above them, and the quantity of water is often comparatively small, the upper water being in a great degree cut off by the superior levels, and conveyed to the cisterns through the latter. The temperature of the water that flows into the ends of the deepest levels is generally as high, or nearly so, as that of the rocks and lode, and more often higher; which it may be presumed it could not be, if much of the upper water were mixed with it. Most of the experiments were made at or near the ends of the deepest levels, in each of the respective mines.

The thermometers employed were placed in holes 15 or 20 inches deep in the rocks and lodes, and were carefully closed up with clay, tow, or cotton, and, after the thermometers had been thus left from half an hour to an hour, they were withdrawn and read off. In taking the temperature of the water, the most copious springs at their sources or influx into the levels were selected, if near the stations where the other observations were made; and the temperature of the surrounding air was also ascertained. The mines visited were situated in different parts of the county, ranging over fifty miles of country, from Fowey to St. Just, near the Land's End.

The following is an epitome of the results:—

Fowey Consols Copper Mine—deepest level 328 fathoms from surface, 298 below the sea. At 268 fathoms from surface, water issued from a copper-lode at 96° 5′ Fahr., the lode was 95° 5′. No persons at work near the place. At 288 fathoms, another lode was 94°; the adjoining rock killas 93°; the air 91° 5′. Par Consols Mine produces copper and tin in killas. Deepest level 208 fathoms from surface, 179 under sea-level; temperature of lode 84°; rock 84°; air 82°. The part of this mine which produces tin was 128 fathoms beneath the surface at its deepest level; the lode there was 74°; the rock 74°; the air 75°; and the water 72°.

The United Mines, in the parish of Gwennap, yield copper-ore in killas. At the eastern end of a level 255 fathoms under the surface, and nearly 200 fathoms below the sea level, a stream of water from a copper-lode gave 116° Fahr., while the neighbouring rock and the air were at 106°. In another level, also at 255 worked on a parallel lode, south of the former, in which there was very little water, the rock was 82° 5′ and the air 82°.

In 1853, Mr. Fox repeated some observations in the Tresavean Mine (situated about eight miles north-west of Falmouth) to ascertain in what proportion the temperature has increased with the increased depth since 1837. The mine has been very productive of copper, found mostly in granite and but very little in killas. The bottom level, deeper than any other in Cornwall, was 352 fathoms, or 2,112 feet under the surface, and about 1,750 below the level of the sea. The lode in this deep level, at its eastern extremity, was 90° 5′; the contiguous granite, 91° 5′; the air, 91° 5′; a small spring of water flowing from the lode, 93° 5′. In 1837, the deepest level in this mine was 262 fathoms, or 1,572 feet, beneath the surface, and the temperature of the rock was then 82° 5′.

Dolcoath (in the parish of Camborne) is a very productive mine of copper and tin, and now yields much of the latter in its deepest part, the containing rock being granite, with killas near the surface. The deepest level on the north lode was 272 fathoms below the surface, and extended only about four fathoms on each side of the engine-shaft; the rock at its eastern end was 73° 5′; the air, 71° 7′; and the water, 73°. At the western end, it was 73° on one side of the level, and 73° 5′ on the other; the air, 73°; and the water, the quantity of which was very small, 72° 7′. At about three fathoms further south, and at the same depth, another lode was worked, the level extending to about fourteen fathoms to the westward of the engine shaft. The granite was found to be at 79° 5′; and the water, which was much more abundant than in the other level, 79° 5′; while the air was at 78°.

In 1821-22, the deepest level in Dolcoath was 230 fathoms from the surface, and Mr. Fox then had an accurate thermometer, 4 feet long, kept in it for more than a year, with the bulb sunk 3 feet in the lode; and it varied from 75° and 75° 5′ to 76° 5′ and 77°; an occasional influx of water having caused a temporary rise of the mercury to the extent of a degree or more.

The water near the bottom of the engine-shaft in 1822 was at 82° at 239 fathoms below the surface; and last year (1857) it was 82° 5′, at 278 fathoms deep.

The deepest level of the Levant copper and tin mine, in St. Just parish, is 255 fathoms below the surface of the ground, and nearly 230 fathoms beneath the sea-level, having been extended horizontally under it through killas. The temperature of the rock near the end of the level was 84° 7′ on one side and 85° 5′ on the other; the water, 85° 5′; the air, 85°. In 1853, the temperature of the rock in this level, when it was not extended so far westward under the sea, was reported to be 87°, and the granite rock at the same level, eastward of the shaft, 74°.

Botallack copper and tin mine is in the same parish. The western levels extend through killas far under the Atlantic, one of them more than half-a-mile from the shore. The deepest level was 188 fathoms from the ground and 180 under the sea-level; the rock near the end being 79° on one side and 79° 5′ on the other; the air, 81°.

These results exhibit great differences in the rates of increase in the temperature in different mines, and also in different parts of the same mine, as will be better seen in the following table, prepared by Mr. Fox, in which the experiments made in the deepest levels are arranged in order of their respective depths, and which exhibits the ratios in feet, in descending from the surface in which the temperature was augmented 1° Fahr. from 50°, the mean temperature of the climate:—

Mines.	Depths in feet.	Dates.	Temperatures.	Increase of 1° in descending.	Rocks.
Par Consols (tin part) ...	768	1837	74° −50=24°	32 feet.	Killas.
Botallack, C. and T.......	1128	1837	79 −50=29	39 „	Killas.
Par Consols (copper part)	1248	1837	84 −50=34	36·7 „	Killas.
Dolcoath, C. and T.	1380	1822	75·5 −50=25·5	54 „	Granite.
Levant, C. and T..........	1530	1853	74 −50=24	63·7 „	Granite.
Levant, C. and T...	1530	1853	87 −50=37	41·3 „	Killas.
Levant, C. and T..........	1530	1857	85 −50=35	43·7 „	Killas.
Tresavean, C...............	1572	1837	82·5 −50=32·5	48·4 „	Granite.
Dolcoath, C. and T.	1632	1857	73 −50=23	71 „	Granite.
Dolcoath, another lode...	1632	1857	79·5 −50=29·5	55·3 „	Granite.
Tresavean, C...............	2112	1853	90·5 −50=40·5	52·1 „	Granite.

On comparing the results obtained in Dolcoath in 1821-22 and 1827, it appears that the temperature was increased only 4° in one level, with an increased depth of 252 feet, giving a ratio between the stations of 1° increase in 63 feet; and in another level the temperature was actually 2° to 2° 5′ less than in 1822, although 252 feet deeper than the mine was then. "These experiments," Mr. Fox says, "were made with great care, and this exceptional case may probably be due to the greater hardness and compactness of the lode in the deeper level and the diminished quantity of water."

The depth of Tresavean was increased 510 feet between 1837 and 1853, and the temperature 8° 5′ in the deepest level, or in the ratio of 1° in 63·5 feet.

Mr. Fox has not included in the above tables the recent results in the United Mines nor Fowey Consols, the experiments not having been made in the deepest levels; but the hot spring at 116°, at the depth of 255 fathoms in the United Mines, gives a ratio of 1° increase in in 23·2 feet; and the rock in another level, also 255 fathoms deep, 1° in 47 feet.

In 1853, the bottom of the United Mines was 275 fathoms, and the rock 94°, or in the ratio of 1° in 37·5. At Fowey Consols, the rock, in a level 288 fathoms deep, was 93°, or in the ratio of 1° in 40·2 feet.

"Widely," continues Mr. Fox, "as the ratios differ from each other in different mines and in different parts of the same mine, the results tend to confirm the statement that the temperature in general increases less rapidly in deep mines than in those which are of inferior depth; and this is more especially observable when experiments are made, from time to time, at the bottom of a mine as the depth increases, unless the results be modified by an increase of water coming from greater depths. It is not, however, to be inferred that the diminishing ratio of temperature in descending into the earth extends to an indefinite depth; it may, on the contrary, and probably does, increase much more uniformly at depths where the circulating water has little or no influence."

"A copious spring of warm water gushing from a vein is hailed by the miners as a favourable indication of the proximity of ore, and so is a pervious or 'hollow' lode; but the former clearly results from the latter, the warm water rising through the lode."

Mr. Fox then briefly remarks upon the qualities of these subterranean waters, and the general absence in them of saline or mineral matter at their issue; while, on the other hand, it is observed that the water collected in the pools in the levels frequently contain metallic salts derived from the ore-heaps broken from the lodes, and exposed to the joint action of air and water. The phenomena observed in mineral veins, however, afford strong presumptive evidence that the water circulating through them has, from time to time, varied much in its properties, sometimes depositing minerals, and at others decomposing them. In concluding, Mr. Fox adds that, on comparing the specific gravities of pieces of different rocks taken from the deepest parts of some of the mines with others of the same kind occurring at or near the surface, he has not found any decided difference between them in that respect.

Mr. Fox's paper is marked by a conciseness and precision which render it difficult to abbreviate it, and in this abstract we have used his own expressions, and have given the details as much length as possible, as there is not even a really superfluous word in the original memoir.

The Report on the Marine Zoology of Strangford Lough, in the Irish Channel, by Dr. Dickie, is valuable to the geologist as well as the naturalist, as a record of the characters of sea-bottom with which certain forms of mollusca are associated, and for the notings of the species to which the broken and dead shells in each locality dredged belonged.

Mr Bowerbank contributes a further report on the vitality of the Spongiadæ. In the former paper by this gentlemen, read at the previous meeting, his observations on the inhalations and exhalation of water through the pores and oscula of the British marine sponge *Hymeniacidon caruncula* were recorded, showing the capability which that sponge possesses of opening and shutting those tubular cavities at pleasure. The present investigations were undertaken to determine the nature and power of the imbibing pores, which can only be seen in young and transparent specimens. For this reason, the author confined his observations more especially to the *Spongilla fluviatilis*, specimens of which can readily be obtained of small size, and presenting favourable conditions for the observation of their porous system. As in the *Hymeniacidon*, the inhaled currents of water carried rapidly in through the numerous pores, the floating particles of indigo, the grosser pieces of which, with the flocculent and fæcal matter, were ejected through the osculum. The period of violent action corresponding, as in the marine species, to the time of feeding, and resolving itself sometimes suddenly and sometimes gradually into the languid, or digesting and aërating, condition. When the incurrent action became rather languid Mr. Bowerbank tells us he observed "That the molecules within the sponge were performing a sort of cyclose circulation, frequently rising up and passing across the open pores, but never coming out through them; but every now and then a molecule of indigo would pass languidly into the pore. It would seem, therefore, to indicate that the organs of incurrent action were situated within the intermarginal cavities, as in *Granta ciliata*, and not immediately around or within the pores."

So little is known of the fossil sponges, and indeed, generally also of the living species, that whatever tends to elucidate the structure and habits of this obscure class, cannot but be of value in the study of the extinct forms, even though it may not seem to have an immediate bearing, as it is only by the knowledge of the recent forms that we can hope to make out and classify the extinct.

The report of the Belfast Dredging Committee is an important document, and interesting from the changes which have of late years taken place by the gradual silting up of parts of the bay, and the consequent influences which these changes have had upon the organic life of the region, especially upon the various species of mollusca.

In the section of Mathematics and Physics is an interesting paper by Mr. J. Nasmyth, "On some Phenomena connected with Molten Substances." The great fact to which he drew attention was, "that all substances in a molten condition were specifically heavier than the same substances in an unmolten state." Hitherto water has been thought to be a singular and special exception to the ordinary law, that as substances were elevated in temperature they became specifically lighter, that is to say, that water at the temperature of 32°, on being heated, does, on its progress towards temperature 40°, become more dense and specifically heavier, until it reaches 40°, after which, if we continue to elevate the temperature, its density progressively decreases. Mr. Nasmyth finds that water is not a singular and special exception in this respect, but that, on the contrary, this phenomenon, in relation to change of density, when near the point of solidification, is shared with every substance with which we are familiar in a molten state. It is on account of this general law that, if we throw a piece of solid lead into a pot of melted lead, the solid or unmolten lead will float in the fluid or molten metal. The same holds good with respect to lead, silver, copper, iron, zinc, antimony, bismuth, glass, pitch, resin, wax, tallow, &c. The normal condition as to density is resumed, in most substances, a little on the molten side of solidification, and in a few cases the resumption of the normal condition occurs during the act of solidification.

Mr. Nasmyth also stated, "that from experiments which he had made, he had reason to believe that by heating molten metals up to a temperature far beyond their melting-point, the point of maximum was, as in the case of water at 40°, about to be passed; and that at such very elevated temperature the normal state as regards reduction of density by increase of temperature was also resumed; but that as yet he has not been able to test this point with such certainty as to warrant him to allude further to its existence."

The author considered these facts worthy of the attention of geologists as the key to the explanation of many eruptive or upheaving phenomena, which the earth's crust, and especially that of the moon, present—namely, that, on the approach to the point of solidification, molten mineral substances beneath the solid crust of the earth must expand, and tend to elevate or burst up the solid crust, and also to express upwards, through the so-cracked surfaces, streams more or less fluid of those mineral substances which were originally in a molten condition.

In the Geological section the papers read were a "Notice of the Occurrence of a Boulder of Granite in the White Chalk of Croydon,"* by R. Godwin-Austen. "On the Carboniferous Limestone Fossils from the County of Limerick, collected by the Irish Geological Survey;" and a description of a "New Fossil Fern from the Coal-Measures near Glin, Co. Limerick," by W. H. Bailey. "On the Drift of West Galway and the Eastern parts of Mayo," by J. Birmingham. "On certain alterations of Level on the Sea Coast of part of the County of Waterford," by Dr. Clarke. In this paper Dr. Clarke described an ancient sea-beach of the coast of the county of Waterford, extending about two and a half miles, and attaining at one spot an elevation of sixty feet. The shells found on it were exclusively those of the *Cardium edule.* "On the Geology of the Neighbourhood of Tralee," by F. J. Foot, of the Geological Survey." "On the Relations of the Rocks at or below the Base of the Carboniferous Series of Ireland," by Sir Richard Griffith. "Notes from the Barbary Coast, with Fossils," by G. F. Habershon. "On the Geology of Caldbeck Fells and the Lower Sedimentary Rocks of Cumberland, and "On the Jointing and Dolomitization of the Lower Carboniferous Limestone in the neighbourhood of Cork," and "On the Records of a Triassic Shore," by Prof. Harkness. "On a Model illustrative of Slaty Cleavage." and "On Fossil Stems allied to Stigmaria, from the Upper Beds of the Old Red Sandstone of Hook Point, Co. Wexford," by the Rev. Prof. Haughton. "On the existence of Forces capable of changing the Sea-level during different Geological Epochs," by Prof. Hennessy. "On the Conductivity of various Substances of Heat," by Wm. Hopkins. "On the Geological Structure of the Dingle Promontory, Co. Kerry," by J. Beete Jukes and G. V. Du Noyer. "Notes on the Old Red Sandstone of South Wales," by J. Beete Jukes. "On the Geology of Lambay Island," by Messrs. Jukes and Du Noyer. "On the Valentia Trap District," by C. H. Kinahan. "On the Zoological Relations on the Cambrian Rocks of Bray Head and Howth," by Prof. T. R Kinahan. In the Cambrian rocks of these two localities traces of organic life of three types at least are abundant. 1st, Zoophytic, *Oldhamia*, of two species, occurring abundantly at Bray, Co. Wicklow, and sparingly at Howth, Co. Dublin; 2nd, Annelidan, tracks of wandering worms (*arenicolites*), arranged in the same direction as the bedding, found both at Howth and Bray. Worm-burrows, vertical to the bedding, and arranged in pairs similar to those of the Longmynd. Worm-tubes, of a new type, for which the name of *Histioderma Hibernica* was proposed. These are regarded as the membranous tubes of a tentaculated worm which inhabited a trumpet-shaped burrow, bent up at the lower end, and they occur abundantly at Bray Head, in a Cambrian sea-beach. 3rd, Molluscan (?); markings precisely similar to those so-called in the carboniferous slates. These are from Bray.

The worm-tracks from Howth do not appear to be identical with those of Bray, all the fossils of which appear to have been deposited in shallow, quiet water. "On the relation between the cleavage of Minerals and the cleavage of Rocks," by Prof. King. "On a Section across Slieve-na-Muck, Co. Tipperary," by T. O. Kelly. "On the Genus Woodocrinus" by L. de Koninck and Edw. Wood. "Notice of the Recent Advances of Palæontological Discovery in Tuscany," by Prof. Car. G Meneghini. "The Quartz-rocks, Crystalline Limestones, and Micaceous Schists of the North-Western Highlands of Scotland, proved to be of Lower Silurian age through the Discoveries of Mr. C Peach," by Sir Rod. Murchison. "Note on the Fossils from Durness," by J. W. Salter.

This discovery, by Mr. Peach, of Silurian fossils in geodes and fragments of unchanged Silurian rocks, entangled and enclosed in altered or metamorphosed rocks, has formed the key to the comprehension of the age and relations of vast accumulations of rock-masses, the age of which were hitherto undeterminable, especially of those of the north-west Highlands of Scotland.

"On the junction of the Mica-slates and granite, Killiney Hill, Dublin," by

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* On this subject Mr. Godwin-Austen has communicated an elaborate memoir to the Geological Society; see the Society's Quarterly Journal for August, 1858.

G. V. Du Noyer. "General Sketch of the districts already visited by the Geological Survey of India," by Prof. Thomas Oldham, Superintendent of the Geological Survey of India. "On the Ironstone in the Oolitic district of Yorkshire," by Prof. John Phillips. "On the discovery of Paradoxides in New England," by Prof. W. B. Rogers. "On the Geological Survey of Pennsylvania," by Prof. H. D. Rogers. "On the Fossils of the Dingle district," by J. W. Salter. "On the Erosion of rivers in India," by H and R. Schlagintweit. "On some facts connected with Slaty Cleavage," by H. C. Sorby.

This last communication drew attention to the microscopical structure of the so-called clay-slates, as being entirely different from the modern deposit of clay, formed from decomposed felspar, or from those occurring in strata which have undergone no subsequent chemical change. Such, in fact, contain little or no clay, in the usual acceptation of the term, but are often almost wholly composed of very minute plates and crystals of a peculiar mica, so that they might be called mica-clay-slates, thus being analogous to very fine grained mica-schists, into which they pass by the increase in size of the crystals of mica.

The form of these particles, and their manner of arrangement, are quite different from that exhibited by rocks merely deposited from suspension in mud, but are extremely like what occur when minute crystals are formed *in situ*.

The opinion of the author is, that such clay-slate as is almost entirely composed of mica was originally a deposit of ordinary felspar-clay, and that, probably under the action of water at a high temperature, this was altered into a mass of minute crystals of mica. This view is of interest as explaining the promiscuous arrangement of the minute particles of mica before the cleavage was developed by pressure.

Two distinct kinds of slaty-cleavage were then pointed out, hitherto confounded under the term slaty-cleavage. One of these, characteristic of the best roofing-slates of Wales, the author styles *ultimate-structure-cleavage*, as being the structure which would result from the rock yielding to pressure as a plastic substance; the amount of absolute compression when cleavage was developed, as deduced from the green spots, indicating the amount of water squeezed out as equal to the quantity required to render the clay quite plastic.

The other extreme structure is a cleavage due to very close joints, often undistinguishable except by the aid of the microscope; whilst the arrangement of the particles in the spaces between them is independent of the joints, and is often related to quite another plane. This kind the author styles *close-joints-cleavage*, and it corresponds with the result of the rock yielding to change of dimensions, like a rigid body, by the formation of close cracks.

As these two kinds of cleavage obey materially different laws, the structure affords an indication of the actual condition of the rocks at the time of their compression, and perhaps, also, in some cases, whether the movements of elevation were sudden or gradual.

"On a Fossil antler of a Stag from the Severn Drift," and "On a New Species of Eurypterus from the Old Red Sandstone of Herefordshire," by the Rev. W. S. Symonds. "On the Geology of the Galty Mountains," and "On the Tertiary Clay and Lignite of Ballymacadam, near Caher, County Tipperary," by A. B. Wynne, of the Geological Survey.

In the Botanical Section there were also papers of interest to the geologist, especially one by Mr. D Moore, on the plants which, by their growth and decomposition, form the principal part of the Irish turf-bogs.

The Rev. G. O'Meara also gave a notice of some forms of Diatomaceæ found in the chalk of Antrim, having the curious result that the majority of 42 forms recognised appear to be freshwater diatoms existing at the present day.

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PALÆONTOLOGICAL NOTES ON THE BRACHIOPODA.

By Thomas Davidson, Esq., F.R.S., Sec. G.S., &c.

No. I.—*On the Genera and Sub-genera of Brachiopoda that are provided with Spiral Appendages for the support of the Oral Arms, and Species so constructed, which have been discovered in British Carboniferous Strata.*

All that pertains to the science of Palæontology is of consequence to the geological inquirer; therefore a few notes and illustrations relative to the Brachiopoda may, perhaps, prove acceptable to the general reader, and, at the same time, stimulate some others to prosecute an inquiry upon which so much time and labour have been already expended.

It was justly observed by a distinguished naturalist, that there exists a decided advantage in the same subject being investigated by a number of different observers; and the truth of this statement has been fully substantiated by the information already acquired on all that concerns the affinities, classification, and anatomical structure of the Brachiopoda.* But it must also be remembered, that, although these topics may have been individually and collectively the subject of considerable investigation, much still remains to be discovered and satisfactorily explained before many of the problems relating to the character and history of the class can be considered as finally determined.

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* The larger proportion of naturalists have been in the habit of considering the Brachiopoda as constituting a separate class among the Mollusca, but anatomists have not hitherto agreed upon this important question. Mr. Hancock has endeavoured to demonstrate the close structural conformity between the Brachiopoda and the Polyzoa, while Dr. Gratiolet dissents from the view taken by Professor Owen, who has placed the Brachiopoda between the Lamellibranchiata and the Tunicata.

All palæontologists seem to agree that the Brachiopoda should be divided into two principal groups. The first will include all those genera and species which have their valves *articulated* by means of teeth and sockets; the second will comprise those forms which, being *un-articulated*, have their valves kept in place by means of muscular and other contrivances.

The *articulated* genera have been provisionally arranged into five families—*Terebratulidæ*, *Spiriferidæ*, *Rhynchonellidæ*, *Strophomenidæ*, and *Productidæ*—while the *un-articulated* comprise the *Craniadæ*, *Discinidæ*, and *Lingulidæ*. But it is not my intention to enter upon the important anatomical features which distinguish the two groups, nor to discuss the subject of their general classification; the present communication being intended solely to convey some information, old and new, on those genera which were provided with spirally-coiled lamellæ for the support of the oral arms. My classification (as well as all others hitherto introduced) is, to a greater or lesser extent, artificial and provisional. Nor is it surprising that, while feeling our way in the dawning light which has but recently begun to rise over the numerous efforts that have been made to extricate this class from the chaos in which it was plunged for so long a period, that we should sometimes have stumbled, and have been obliged to retrace our steps, or even to abandon certain conclusions which may have been considered, for a time, as established upon a stable foundation.

No recent Brachiopod hitherto discovered, has been found to possess calcareous spiral processes, so that we cannot determine by a direct anatomical examination, the exact relation of these calcified appendages to the soft parts of the oral arms; but, as these are still existing among the articulated genera, in two species of *Rhynchonella* in which the fleshy arms, although free and unsupported, are spirally coiled and directed inwards towards the concavity of the smaller or dorsal valve, in a very similar manner to the broad spirally-coiled lamellæ in the extinct genus *Atrypa*, we may, to a certain extent, be allowed to conjecture upon the probable relations of the calcareous processes to the soft parts of the oral arms.

Dr. Gratiolet is of opinion that the median arm of Terebratula is in

Rhynchonella psittacea divided into two largely-developed arms with a single row of cirri, and without any testaceous support, but that the reverse was probably realised in Spirifera, where the median arm is supposed not to have existed; and that the cirri were exclusively borne by calcareous spiral appendages, divided into two halves, independent of each other, and completely symmetrical; but further research will be required before this important point can be completely determined.

The oral arms appear to have differed much in position and detail. They were variously coiled in all the articulated genera, with the exception of those that compose the great family *Terebratulidæ,* wherein the median arm alone was spirally coiled. In *Rynchonella, Strophomena,* and *Productus,* the arms were spirally coiled, but unsupported by any testaceous appendages; while in *Spirifera, Athyris,* and their subgenera, the oral arms were supported or borne by two long ribbon-shaped lamellæ spirally coiled, and with their extremities directed outwards. In *Atrypa, Davidsonia, Koninckina,* and *Anoplotheca,* the two spirally-coiled lamellæ were vertical and directed towards the bottom of the valve, or horizontally disposed, each coil being nearly on a level with the bottom of the valve. Their principal conditions were, therefore, assumed by these spirally-coiled arms, and by their supporting processes; and a very important question has arisen,—that is to say, whether we can or ought to place in the same family, animals in which the spiral arms were free, and those in which they were borne or supported by calcified spiral lamellæ? Mr. S. P. Woodward is of opinion that *Atrypa* should be removed from among the *Spiriferidæ,* and be added to the *Rhynchonellidæ,* considering the calcification of the oral supports to be a *character of uncertain value?* And this view is certainly deserving of some further consideration, although I felt disposed, while composing my General Introduction, to place Dalman's *Atrypa* in the same family with *Spirifera* and *Athyris.* Among the Terebratulidæ it has been ascertained that, in some species, the oral arms were supported at their origin only, as in *Terebratula vitrea, T. caput-serpentis,* &c., while in other genera the ribband-shaped lamellæ or loop extended for a considerable distance into the interior of the shell, as in *Waldheimia, Terebratella, &c.;* but, although the shape and extent of the calcareous processes may have served as a good character for the grouping of similar forms into the same genus, still their presence or absence does not appear to have very materially interfered with the development of the arm itself, or of its connecting membrane; and it is therefore to be presumed that something similar did occur among the species with spiral arms.

The question relating to the classification of the species with spiral supports is still a matter which will demand some further consideration; but it seems to me that the genera and sub-genera may be, for the present at least, arranged into the following separate groups:—

1 Genus Spirifera, Sow., type *Sp. striata*, Martin.
? Sub-genus, *Cyrtia*, Dalman, *C. exporrecta*, Wahl.
„ *Spiriferina*, D'Orb., *Sp. rostrata*, Schloth.
„ *Suessia*, E. Deslong., *S. costata*, Desl.
„ *Cyrtina*, Dav., *C. septosa*, Phillips.

2 Genus Athyris, M'Coy=*Spirigera* d'Orb. *A. concentrica*, V. Buch.
Sub-genus, *Merista*, Suess, *M. Herculea*, Barrande.
„ „ *Retzia* King, *R. Adrieni*, De Vern.
„ „ *Trematospira*, Hall, *T. perforata*, Hall.
„ „ *Nucleospira*, Hall, *N. ventricosa*, Hall.
„ „ *Uncites*, Def., *U. Gryphus*, Def.

3 *Genus* Atrypa, Dalman=*Spiriferina*, d'Orb., *A. reticularis*, Linnæus.

4 Genus Koninckina, Suess, *K. Leonhardi* Weissman.
„ Anoplotheca, Sandberger, *A. lamellosa*, Sandb.
„ Davidsonia, Bouchard, *D. Verneuilii*, Bouch.

Nos. 1, 2, and 3 have been grouped by myself and others into a single family, *Spiriferidæ*, but Mr. Woodward has excluded the third, which he has added to the *Rhynchonellidæ*.

A family, *Davidsonidæ*, was proposed some years ago by Professor King, in which some authors would comprise *Anoplotheca* and *Koninckina*.

The characters which distinguish *Spirifera*, *Athyris*, and *Atrypa* have been so clearly defined, that there can exist no possible doubt as to the propriety of maintaining all three as well-established *genera*.

The shells which compose Sowerby's remarkable and widely-spread genus, Spirifera, differ exceedingly in their external shape, some being transverse, while others are elongated, rounded, smooth, angular, variously ribbed or striated, with or without a mesial elevation in the smaller valve and a sinus in the larger one, all possessing, however, a straight hinge-line, but very variable in length; the larger valve is provided with a flat or concave, triangular or sub-parallel *area*, which varies in height, width, and extent, according to the species; the area is divided by a triangular fissure, open in the fry, but becoming gradually more or less contracted with age, from the production and development of one or two curved plates, notched in the vicinity of the cardinal edge, and to which the term pseudo-deltidium has been applied. In the smaller valve there exists also a narrow hinge-area. The valves of *Spirifera,* and of all the genera and sub-genera of this family, articulate by the means of curved teeth developed on either side, at the base of the fissure, and fitting into corresponding sockets in the opposite or smaller valve. In the larger valve, the teeth are supported by vertical shelly plates, which, after having formed the walls of the fissure, extend from the beak to the bottom of the valve; they are small or large, regularly diverging, or converging to diverge again, and extend to a greater or lesser distance into the interior of the valve. Between, and at times beyond these plates, the larger portion of the bottom of the shell is filled up by muscular impressions, sometimes divided by a blunt longitudinal crest. The adductor or occlusor muscle, which is destined to the function of closing the shell, leaves a narrow mesial longitudinal and oval-shaped scar, and on either side are situated the cardinal or divaricator muscles, the antagonists of the occlusors, and the office of which was to serve in the opening of the shell.* In the interior of the smaller or dorsal valve there exists two large conical spiral coils which nearly fill the interior of the shell, the ends being directed outwardly towards the cardinal angles, while the basis of the hollow conical spires nearly meet at the hinge-side, but are wide apart in front. The hinge-area is divided into two portions, to which the principal stems of the spire are attached, and in the notch under the extremity of the umbonal beak there exists a calcareous projection or cardinal process, to which was attached the other extremity of the cardinal or divaricator muscle. A little lower down on the bottom of the valve, are seen four large elongated impressions left by the adductor—the anterior or posterior occlusor muscle of Hancock. Therefore, although we have not been able to discern clearly in the larger valve of Spirifer, those impressions formed by the accessory divaricator, ventral pedicle, or adjustor muscle, nor that of the dorsal pedicle or adjustor in the smaller valve, it is nevertheless probable that these muscles did exist, but have not left such defined impressions in the interior of the shell as we perceive in the corresponding valves of Terebratula.

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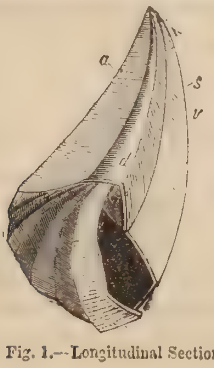
* For ample details upon this subject the reader is referred to Mr. A. Hancock's admirable Memoir "On the Anatomy of the Brachiopoda," recently published in the Transactions of the Royal Society.

The sub-genus *Spiriferina* presents some well-marked features by which it may be distinguished from *Spirifera* proper. Thus, notwithstanding its external resemblance to the last-named genus, the shell-structure of *Spirifera* does not present a vestige of that system of canals or perforations, which traverse the shell of all the species of *Spiriferina* hitherto discovered, and which peculiarity must have been accompanied by other important modifications of the animal structure which cannot be entirely ascertained; but certain evidence of this is evinced by a difference in the interior arrangement of the larger or ventral valve,—for in all species of *Spiriferina* there exists, between the diverging dental or rostral plates, a largely-developed mesial septum which is never present in *Spirifera*, and to which was attached the adductor or occlusor muscle. *Spiriferina*, therefore, although more nearly allied to *Spirifera*, and perhaps to *Suessia*, than to any of the other genera, may advantageously preserve the name, to designate those species which, in addition to a perforated shell-structure, present a largely-developed mesial plate in the interior of the ventral valve. The sub-genus *Cyrtia* was created by Dalman to receive those few *Spirifera*-shaped species which possess a circular foramen, or aperture in the deltidium of the larger valve—the author did not furnish us with any other information regarding the internal arrangements of his two named types, *Cyrtia exporrecta* and *C. trapezoidalis*. Subsequently to 1827, several other species were added (by different authors) to the so-termed genus *Cyrtia*, and among these are some the shell-structure of which has been stated to be perforated, while that of Dalman's type is unpunctate, as in *Spirifera* proper; but it was not until very recently that I was enabled to discover some of the characters of the following species:—*C. exporrecta, C. trapezoidalis, C. Murchisoniana, C. cuspidata, C. heteroclyta, C. Demarlii*, and *C. septosa*. The results of my examination will show that in the first four which belong to Dalman's genus, the internal characters are similar, but different from the last three, which cannot with propriety be retained in the same group, or with the same denomination, for it is evident that considerable dissimilarities in the arrangements of the plates of the ventral valve must have carried along with them some important differences in the soft portions of the animal, and I have therefore proposed (at least provisionally) to distinguish the little group of spiriferous shells of which *C. heteroclyta*, *C. Demarlii*, *C. septosa*, *C. dorsata*, and, perhaps, *C. carbonaria*, are examples, under the sub-generic appellation of CYRTINA, and to leave that of CYRTIA to those shells which agree with *C. exporrecta*, *C. Murchisoniana’* &c.; but it is also necessary to observe that Dalman's genus is in itself founded upon a character of such little value that it will remain a question for further discussion whether the name should be retained, or be added to the synonyms of Sowerby's *Spirifera.* In CYRTIA a short hinge-tooth is situated on either side at the base of the fissure, supported by vertical shelly plates which diverge and extend from the extremity of the beak, forming the fissure-walls, and occupying about one-third of the length of the bottom of the valve, exactly as we perceive to be the case in many species of *Spirifera.* There exists in Cyrtia no median plate or septum, nor does any occur in Spirifera, but the arched-shaped deltidium which covers the entire fissure is generally, although not always, perforated by a circular foramen which is sometimes even tubular, as in certain Chinese examples of *Cyrtia Murchisoniana.* In the smaller valve, the spiral appendages are directed outwards, nearly filling the cavity of the shell; and their mode of attachment is exactly similar to what we find in *Spirifera.* Therefore, *Cyrtia* presents no other features by which it can be separated from *Spirifera* than those of its deltidium and foramen, which are characters of hardly sufficient importance to warrant the creation of even a separate sub-genus. In the CYRTINA, however, the diverging plates above described do not exist; but we find in the interior of the ventral valve, two contiguous vertical septa which coalesce into one median plate, extending from the extremity of the beak to within a short distance of the frontal margin,



a. Half of the Area.
d. Deltidium.
v. and *x.* Dental plates.
s. Median septum.

Fig. 1.—Longitudinal Section of Cyrtia heteroclyta.

and then diverging to form the dental plates in a very similar manner to what we find in *Pentamerus*. The fissure is covered by an arch-shaped deltidium; but in *C. Demarlii*, Mr. Bouchard has remarked that the median septum is continued as far as under the surface of the deltidium, so that the dental plates are fixed to its sides instead of to the upper edge, as in *Cyrtina heteroclyta* and *C. septosa*. The arrangements in the smaller or more important valve are still unknown, notwithstanding the many efforts I have made to pry into the interior; and since no vestiges of spiral coils have hitherto been noticed, the character of the genus or sub-genus cannot be at present definitely determined; it is to be hoped that those who reside in districts where some of the species of *Cyrtina* occur, will endeavour to discover the interior arrangements of the smaller or dorsal valve.

The next *sub-genus* which claims our attention is the one named *Suessia* by Mr. E. Deslongchamp; but, as its interior characters are as yet imperfectly known, more information will be required in order to establish its generic or sub-generic claims. The two branches which constitute the first spiral coil are united by a transversal shelly band, from the centre of which proceeds another short lamella, which is directed towards the bottom of the valve. The species that compose this small group possess an unusually large hinge-plate, as well as two singularly-shaped appendages, which, arising from the inner socket walls, follow an inward direction. No other member of the *Spiriferidæ* has presented a similar feature.

(*To be continued.*)

ON ROCKS; THEIR CHEMICAL AND MINERAL COMPOSITION, AND PHYSICAL CHARACTERISTICS.*

By H. S., Plymouth.

1.—*General Introduction.*

I. "Il suffit de parcourir des parties très circonstrites de la surface du globe, pour voir qu'elle est composée de matériaux très-variés."† The most striking of these differences were, of course, noticed even in the least civilized times; and, as observation advanced, and experience accumulated, the minor and less obvious variations of constitution and texture were gradually reduced to order, and classified into the science of Mineralogy.

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* In case any of my readers, being young geologists, should misapprehend the exact geological meaning of the word *rock*, I give Sir Charles Lyell's definition:—"The materials of the earth's crust are not thrown together confusedly; but distinct mineral masses called 'rocks' are found to occupy definite spaces. The term *rock* is applied indifferently by geologists to all these substances, whether they be soft or stony; for clay and sand are included in the term, and some have even brought peat under this denomination."—"Elements," p. 2.

† D'Aubuisson's "Geognosie" par Burat.

II. So far our science concerned itself merely with what we should now call a correct description of the *mineral character* of rocks, without entering into the question of their genesis or mode of origin. But at the dawn of geology—that is, when men first conceived that the various rocks and strata at the surface of our earth were formed at different, and often immeasurably remote periods—then the study of rocks entered on a new phase. The age and succession of these formations were judged, in the first place, from the order of their superposition; and when it was found, as a general rule, that each formation, or stage of this succession, was marked by rocks of a specific mineral character, it was hastily concluded that this mineral character was typical of their age, and that the latter could be deduced from the former: nor was this generalization devoid of broad principles of truth; the ancient and more recent formations are each undoubtedly composed of rocks of very different mineral character—the former being made up such of rocks as granite and the so-called primary limestones and clay-slates, while the latter consists of clays, chalk, or slightly consolidated sandstones.* At any rate this notion served its day, was not without its advantages, and was particularly useful in the impetus which it gave to the careful study of the mineralogical character of rocks.

III. We consequently find in most geological works published in the early years of the present century, a full description and classification of all the principal rocks, and also a mineralogical description of the rocks constituting every formation treated of. But after William Smith's discovery all this was changed; and, when it was finally recognized that strata of every age could be distinguished without doubt or ambiguity by their contained fossils, geology became absorbed in Palæontology. The mineralogical study of rocks was neglected and despised; the most eminent geological writers were content, in their handbooks, servilely to copy from Macculloch or Jameson their mineralogical descriptions; and voluminous works appeared on various formations without a direct reference to the mineral character of any of their comprising rocks.

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* Recent experience has shown what very erroneous conclusions as to the age of rocks we may draw from mineral character alone. "The hillocks of slightly coherent mud, marl, and sand, near St. Petersburg, are truly of the same age as the slaty mountains of North Wales," although they differ little in mineral character from the London tertiaries; while on the flanks of the Rigi, in the Alps, at the height of 8,000 or 9,000 feet, "deposits formed at the same time as our slightly consolidated London clay have been in many parts converted into schists and slates, as crystalline as many of the so-called primary rocks of our islands."—"Siluria," pp. 18, 503. Still these are exceptions; in nine cases out of ten, the crystalline rocks will be found to belong to the old formations, and the slightly consolidated to the new.

IV. Within the last two or three years, however, a reaction has commenced, and the attention of numerous geologists in this country is now directed to the study of various phenomena connected, more or less closely, with the consideration of the mineral and chemical constitution of rocks. On the Continent enormous progress has been made by patient chemical researches, by which an entirely new light has been thrown upon the subject of the genesis of many rocks. The results of the labours of Delesse, Bunsen, Bischof, Charles Deville, Daubrée, and many others in France and Germany, and, of late years, those of some of our own countrymen, especially Sorby, now induce us confidently to anticipate that during a few ensuing years the progress of chemical and mineralogical geology will lead to results not less important and marvellous than those that have followed during past years from the investigations of palæontologists.

V. The study of rocks naturally falls into two divisions. The first is purely mineralogical and descriptive, and merely aims at giving a correct description, and forming a comprehensive classification, of the various rocks according to their *mineral* contents; ascertained, when possible, by inspection with the naked eye or with the lens or microscope, aided by the ordinary mineralogical tests; or, when the several constituent minerals are so intimately mixed as to be undistinguishable by these means, then by chemical analysis. This mineralogical and descriptive branch of the science of rocks is of the greatest value to the practical geologist, both for scientific and economical purposes, but is lamentably neglected in England, where gross inaccuracies in the descriptions of the most abundant rocks are of constant occurrence, and committed by men who would shudder at the least error in any palæontological detail.

VI. In the second division of the subject we do not regard rocks according to their *mineral* constituents, but rather according to their *chemical* constitution. Our object is not merely to describe and classify them as we now find them to exist, but to endeavour to deduce, from a careful comparative study of their chemical constituents and chemical changes, the laws of their formation, the circumstances of their origin and subsequent changes, and generally "to investigate their genetic history." Nor is this division of the study of rocks—which has been called chemical geology—a subject of minor or even secondary importance. Upon the result of these investigations depends the solution of many geological principles of the very first importance which palæontology is powerless to unravel. The great question of the metamorphic origin of the crystalline schistose rocks, and even of granite itself, resulting from processes similar, both in kind and degree, to those now in action beneath our surface, can only be proved or disproved by patient investigations in this branch of science. And upon this, again, depends the final decision as to which of the two contending doctrines of geology shall prevail—that of Uniformity or that of Progression: whether, in this world of ours, we can trace back the evidence of the existence of another order of things—a state of incandescence gradually cooling down, followed by alternate periods of tranquillity and of great convulsion; or whether all evidences of a beginning are beyond our view, the present order of things having rolled uniformly on during ages vast beyond our imagination—marked certainly by periods of disturbance and of repose, succeeding each other in different parts of the globe, but uniform on the whole. With such objects and investigations for ultimate results none can consider this branch of geology unworthy of attention; at least no one who wishes to keep himself up with the progress of geological science should fail to acquire a sufficient knowledge to enable him to follow the labours of others, if even he feels no desire ultimately to follow it out practically in the field or the laboratory.

VII. Although no work has, of late years, been published in the English language on the subject of rocks, many important works have appeared abroad, particularly in Germany. Within the last three years, there has been published in that country Professor Cotta's *Gesteinlehre*,* Dr. Senft's *Classification and Description of Rocks*,† besides the division *Petrographie* in Professor Naumann's *Geognosie*[*]. Each of these works possesses characteristic excellences, and, taken altogether, they may safely be considered to exhaust the subject. For theoretical views and general principles, Naumann undoubtedly stands first; Senft is the most elaborate, both in classification and description—sometimes too elaborate; while Cotta is to be preferred by those who require a practical description of individual rocks unincumbered by endeavours after a perfect system of classification.

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* Cotta.—*Die Gesteinslehre.* Freiberg, 1855, pp. 255.

† Senft.—*Classification und Beschreibung der Felsarten.* Breslau, 1857, pp. 442. An abstract of the leading chapters of this work may be found in the "Quarterly Journal" of the Geological Society, Vol. XIV., part II, miscell. p. 1., &c.

VIII. With such recent and elaborate works as these in existence from the pens of men of such high scientific position, it would be the merest folly to make any attempt at originality. My object, therefore, in these papers will be merely to condense and arrange the most essential portions of their information, embodying at the same time as much of the labours of Bischof,[†] Bunsen, Delesse, and others as may be necessary to bring before the readers of the GEOLOGIST a complete view of our present knowledge on this important branch of our great science.

In carrying out this plan, I have divided the entire subject into four leading divisions, as follows:—

1. On the various chemical and mineral constituents of rocks, and their general relations.
2. On the structure, texture, and physical characteristics of rocks.
3. On the classification and description of rocks.
4. On the origin and metamorphism of rocks.

(*To be continued.*)

THE COMPARATIVE GEOLOGY OF HOTHAM, NEAR SOUTH CAVE, YORKSHIRE.

By the Rev. T. W. NORWOOD, of Cheltenham.

HOTHAM is a small village between the towns of South Cave and Market Weighton, in the East Riding of Yorkshire, situated upon the Lower Lias formation, about five miles above where that zone crosses the Humber at Whitton and Brough.

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[*] Naumann.—*Lehrbuch der Geognosie.* Leipsic, 1858. (New Edition). Vol. I., pp. 381-776. In French, I may refer to Professor Coquand's *Traité des Roches.* (Paris, Baillière, 1857), and D'Orbigny's article *Roches* in the *Dictionnaire Universale d'Histoire Naturelle.*

[†] *Elements of Chemical and Physical Geology.* Translated by the Cavendish Society. Two Vols.

Several interesting rocks of the secondary series pass by this village, generally in bands of inconsiderable thickness, and in a direction nearly N.W.N. In most other districts widely separated, they can here be examined near a single point; for we can walk in about two miles from the New Red Sandstone, across the Lias and Oolite, to the top of the Chalk. And as these rocks are, in part, little known, and, in part, have been long held to be exceptional and peculiar—moreover, as they seem to me to throw light upon questions not quite settled at the present time—such as the existence of the *Bone-Bed* and *Insect-Bed*, at the base of the Yorkshire Lias, and of the *Inferior Oolite* in the long litigated neighbourhood of Cave—I am induced to offer some observations upon them, which I made at Hotham during two very short vacations, and which, I trust, will be found to be of general, as well as of local interest. The purpose of this paper will be, to compare some of the most important formations occurring near Hotham with the same formations as they are more typically represented, and more familiarly known, in other parts of England.

(I.) The road from North Cave to Market Weighton, through South and North Cliffe, lies, for about four miles, in the direction already indicated, under a low and regular range of hill, which slopes down close upon it on the right hand side. This range is the escarpment of the *Lower Lias limestones and shales*, which may here be seen resting conformably upon the New Red Sandstone, and presenting to the west, that gently-elevated line of richly-wooded country, which commonly marks the junction of these two rocks. Immediately on the other side of the road there stretches away a wide-extended level plain—sandy and barren towards the N.W., where it is broken by the insulated hill of Holme, and contains the famous lake of *Bealsbeck;* but covered towards the S.W., in the neighbourhood of the rivers Ouse and Humber, by great depths of alluvial accumulations.

The numerous pits which have been dug along this ridge of Lias, for the purpose of marling the light sandy lands adjacent, afford good opportunities for noting the character of the formation, and collecting its distinguishing fossils. There are the usual alternations of shales and bands of limestone which we see along the cliffs of the Severn, in Gloucestershire, and wherever else this part of the Lias is exposed.

The fossils, also, are identically those which we should expect. Reckoning downwards from the top of the ridge, we have *Gryphæa* *incurva* in profuse abundance; an occasional thick cast of *Homomya,* and *Cardinia Listeri,* with its varieties *hybrida* and *imbricata;* all these often imbedded in fox-coloured ragstones of indurated clay; then *Lima gigantea,* in bright and beautiful specimens, exceedingly prevailing in the bands of limestone; *Lima antiquata, Pentacrinus tuberculatus, Pinna folium, Pecten, Avicula;* two species of *Ammonites,* in the state of broken and undefinable casts; a *Unicardium,* a large oval *Cardinia,* fragments of wood, microscopic round-mouthed *Terebræ,* spines of sea-urchins, masses of *Vermetus;* a single *Caryophyllia (?), Ostrea minima (syn. Liassica*), *Modiola minima,* and a larger species, and slabs extremely crowded with the larger *Posidonomya* (so called by the late Mr. Strickland), which is here found associated with the small *Modiola* and *Cardium* that accompany it in the south. The "*Posidonomya-bed*" can be better examined at Hotham than at any other place with which I am acquainted. About Coombe Hill, in Gloucestershire, this fossil may occasionally be found lying on the ploughed lands, but chiefly as a cast, and in a bouldered state, whereas, at Hotham, it occurs in dense layers, and in every state of growth, imbedded in a very fine-grained, dark-blue stone, of a whitish colour externally, the sections of which exhibit lines indicative, sometimes, of a very gently rippled, and, sometimes, a most peaceful lamination. This bed makes excellent roadstone, being very hard and intractable, and splitting rather vertically than in the direction of its deposit. The dense layers seldom contain any other shell besides the *Posidonomya,* though there is, at times, an admixture, in subordinate numbers, of the characteristic *Cardium* and *Modiola* of Gloucestershire. One slab in my possession, not two inches thick, is exclusively occupied on one side with *Posidonomya,* and on the other with the *Cardium* and *Modiola.* The former of these shells is very difficult to be detached from its matrix in a perfect state. Portions of it may be obtained for microscopic examination, but as yet I have never seen the hinge.

I was deceived by this stratum into the expectation that I might, perhaps, find the "Bone-bed," and "Insect-bed" in this range at Hotham. The Lowest Lias may be seen in the marl-pits, passing conformably into New Red Sandstone, by alternating layers of Lias and sand disposed horizontally in slightly-wavy lines. This transition is apparently abrupt and sudden, and is completed in a very few feet, so that we have beds of fine, *red-coloured* sand hastily exchanged for shales and limestones of true Liassic colour and consistency. At these points particularly, and along that part of the escarpment between North Cave and South Cliffe, I made diligent search for the "Bone-bed," and "Insect-bed," on two consecutive days, without success. Neither can I learn, upon full inquiry, that any remains, either of fishes or saurians, have ever been found in these pits. Consequently, I conclude, both from my own experience and the testimony of several intelligent persons, that the *Bone-bed,* "with bones," does not extend into Yorkshire, or, at least, is absent in this locality. Neither was I more successful in my search for the *Insect-bed,* though I should not be surprised to learn, hereafter, that these finely-laminated limestones at the bottom of the Hotham Lias, have preserved some insect-remains. I was often almost disappointed in cleaving them that no wings occurred to me. A more detailed and special examination of this zone by such a hand as Mr. Brodie's, might bring to light some hidden treasures; meanwhile I have nothing more to record concerning it.

The dip of the strata seems very gently eastward, and could be readily estimated with exactness in the roadside-cutting leading to Hotham village,—a section which deserves attention, both for its stratification and its fossils.

Although the Lower Lias series is present here in great thickness, and, possibly, in all its members, yet I have found no means of studying any of its zones higher than that of *Gryphæa incurva,* till we come to the highest of all, where it forms the base of the *Marlstone* in the township of North Cave. And, excepting a single example of a large *Pleurotomaria Anglica,* dug out of a marl-pit between North Cave and Hotham, I am scarcely acquainted with any other of its fossils than those which I have already enumerated.

A very great destruction has happened to this formation in and around North Cave, reducing the range of hill of which I have been speaking to the level of the sandy country on the west, sweeping far away its softer constituents, and piling up in great thickness, over limited areas, the shattered fragments of its harder limestones in the state of a disjointed and water-worn drift. Thus the northern side of the village of North Cave is built upon a thick mass of drift, which at the places where I measured was ten feet deep, and almost wholly composed of small rounded fragments of the "*Posidonomya-bed.*" Similarly, in the "Sandy Lane," between North and South Cave, there is an extensive, thick, and remarkable drift, chiefly consisting of vast multitudes of *Gryphæa incurva,* in a rolled and broken state, with a small proportion of bits of chalk-flints from the Wold. This drift, which represents the destruction of the "gryphite-zone," underlies the lane for nearly two miles, and the number of its gryphites is beyond all belief. Again, close by, at the village of Everthorpe, there is a deep cutting through a drift which is entirely of chalk; and a wide-spread covering of comminuted chalk-flints, small enough to be used for gravel, overlies the Lias under and around all the east, and south, and west of North Cave.

These various beds of "Local Drift," deposited so very near together, are remarkably distinct from, and independent of each other. We can say with certainty whence each was derived; but, as I have never seen them in superposition, I can give no clue at present to their relative ages. They appear to enclose only such organic remains as appertain to their native rocks; and the Liassic portions are so strictly local, that they may almost have been destroyed and re-arranged in the places where we now find them. There has been a similar destruction of the "Gryphite-bed;" on the other side of the Humber, at Whitton, where the débris is precisely of corresponding appearance; and, speculating sometimes upon the origin of these drifts, I have been inclined to attribute them to the action of the river, at a time when it flowed much higher than it does now,—a time of which there is ample evidence along its shores. This, however, be it said, is a mere speculation, and must be taken accordingly at what it may be worth; for this kind of drift is generally difficult of explanation, and not less so here than in other districts.

(To be continued.)

THE SPIRIT OF GOOD BOOKS.

CAMBRIDGE ESSAYS, 1857.—GEOLOGY: BY W. HOPKINS, M.A., F.R.S., F.G.S.

The object of this essay is to view the science of Geology on a more extended scale than is generally attempted in popular treatises; not dwelling on matters of detail, but regarding physical principles and fundamental propositions with those logical sequences by which remoter conclusions are arrived at.

"But how, it may be asked, is the student or mere general reader to enter upon these larger views of the subject without a previous acquaintance with its details? And, doubtless, if any one would make himself an accomplished geologist, and prepare himself to enter fully into the more profound investigations of the science, he must gain a knowledge of its phenomena with a certain degree of detail; but the more complete a science becomes as a science of observation, the less necessary is it for the philosopher who would solve its physical problems to become himself an observer. Newton and Laplace troubled themselves little in looking through astronomical telescopes. They took their facts on the authority of others. And so, also, the general geological reader may accept the facts established by the observations of the field-geologist, when he would acquaint himself with the conclusions of those who have endeavoured to solve the physical or palæontological problems which the science presents to us."

Passing over, as untenable, the dogma of Chateaubriand and others, that God created the world as it appears at present, the author proceeds to regard geology in the light of a physical science determining the nature and operations of those physical causes, which have produced the phenomena presented to our view.

"And here its peculiar and distinctive character must not be forgotten—its historical character. It deals not so much with that which *is*, as with that which *has been*. As ordinary history treats partly of events and institutions belonging to a continuous chain, of which the first links are lost in the darkness of remote ages, and partly of those of comparatively recent origin; so geology deals partly with a series of natural phenomena, linked together by the agency of recognized physical causes, till we ascend to that high antiquity in which Nature's records become illegible; and partly, also, it treats of things—new forms of organic life—which appear to have had no existence whatever before the epoch at which we recognize their introduction on the surface of the earth. How, then, are we to connect this introduction of totally new objects with the ordinary sequence of events connected by natural causes? Are such objects—intruding themselves, as it were, upon the face of the globe, without traces of ancestry or discoverable antecedents of any description—are they to be referred to the operation of ordinary causes, or to some higher order of causation, or to immediate acts of Creative power? These are questions of deep interest to thoughtful and speculative minds anxious to discover some glimpses, however dim, of the manner in which God has chosen to deal with His material universe."

The author then adopts, as the fundamental principle of geological reasoning, that—"*The phenomena which geology presents to us as objects of physical investigation are to be referred to natural causes, so far as it can be shown that they would be the necessary consequences of such causes acting under conditions, the former existence of which may be deemed admissible.*

"The limitation expressed in the preceding enunciation is obviously necessary, in drawing the line of demarcation between those conclusions of the science which rest on certain, and those which rest on controvertible principles. Some assumption must also be made as to the nature and action of the natural causes of which we recognize the agency in those remote ages to which geology refers." If researches analogous to those which have been crowned with such complete success in reference to the solar system should hereafter be made with respect to those nebulæ or clusters of stars which lie in the remoter regions of space, they will doubtless be founded on the hypothesis of the universality of gravitation, and of the laws which regulate the production and propagation of light, heat, and electricity, or of any other physical law which may be necessary in our investigations. And the same invariability which we are prepared to recognize in reference to space, we would equally recognize in reference to time; and would distinctly assert the law, *that all physical causes acting under given conditions are to be regarded as having produced, in all past time, the same effects as the same causes, acting under the same conditions, would produce at the present time.* Thus we assume the constancy of the law according to which different particles of matter attract each other, and also of the laws which govern the propagation of heat through solid and fluid bodies, and of its influence in converting solids into fluids, or fluids into gases. In short, we assume that all physical causes have always acted according to the same laws, and, when acting under identical conditions, with the same intensity.

This hypothesis has been more or less confounded with another hypothesis—that the earth must have been for an indefinite period of time in a physical state essentially the same as that in which it now exists. To confound them is a great error; for it is extremely difficult to understand how the causes of which we recognize the agency in geology can have continued to operate for an indefinite length of time without changing the state and condition of the terrestrial mass on which they have been acting.

As some curves, known to geometricians, are so nearly related to straight lines, that, if we were to examine any part of the extended portion running besides its asymptote, it would appear so like the straight line that our senses would not appreciate the difference, "so it may be with our planet. However slow may have been the process of change, even during all geological time, it may have been like the tardy change of direction in our curve in its infinitely extended branch, towards its asymptotic direction. It may be that the earth, instead of having never deviated materially from its present physical condition, has been, and is still, departing from some primitive state widely different from its actual one, and approaching to some ultimate condition to which it can only attain, under the action of recognized physical causes, after an indefinite period of time, though its approximation to that ultimate condition not only is now, but has been for an enormous period of time, so near as to admit of no change the rate of which can be deemed perceptible."

In the early stages of a science, the observed phenomena are little more than so many insulated facts, but with accumulated observations there arises a necessity for classification. The phenomena thus classified are suggestive of hypotheses as to the physical causes to which the phenomena are due, and hence the science becomes inductive.

The subject is, then, thus divided:—

1. Descriptive Geology.—The description of the observed phenomena of inorganic matter, and this arrangement into groups exhibiting the laws by which they may be connected.

2. Palæontology.—The branch which treats of the phenomena of organic matter, and of the stratigraphical and geographical distribution of fossil organic remains.

3. Physical Geology, which comprises all those investigations and discussions by which we endeavour to connect the phenomena with the physical causes to which they are due.

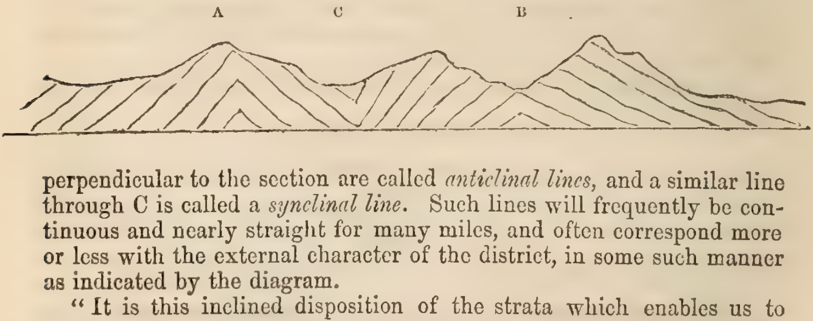
In accordance with this plan, Mr. Hopkins now proceeds to state the broad generalizations of this science and the conclusions immediately deducible from them, restricting himself to those points, whether facts or theories, which are regarded as firmly and finally established; and afterwards discussing some questions of high speculative interest, on which there still remains room for differences of opinion. The first fact to which attention is directed is "the division of the superficial portion of the earth's crust into two distinct portions, stratified and unstratified.

"The unstratified portion of the earth's crust is distinguished by the total absence of all stratification. In some cases there are planes of separation, termed *divisional* or *structural planes*, which might, at first sight, deceive an inexperienced eye, but which are soon seen to be totally distinct from *planes of stratification*. Its calcareous, siliceous, and argillaceous constituents exist much more in mineralogical combination, the first being in much smaller proportion, and the general structure is far more crystalline than in the stratified mass. Granite may be instanced as one familiar form of unstratified rock.

"But there is a far more important and significant distinction between these stratified and unstratified masses. The former contains within it, imbedded in almost every stratum, the remains of organic objects, animals and plants; whereas no trace of such objects is found in the unstratified mass. They comprise great numbers of bones of vertebrate, and shells of invertebrate animals, with numerous remains of zoophytes. The great majority of these remains are completely mineralized, every particle of animal or vegetable matter having entirely disappeared, and been replaced by mineral substances. It is beautiful to observe the exquisite delicacy of the process by which this substitution has been effected, the most delicate characters being as perfectly preserved as in a living specimen. The preservation of the most fragile objects, as delicate shells and stems of corals, is an important fact in reference to the process by which they were originally entombed.

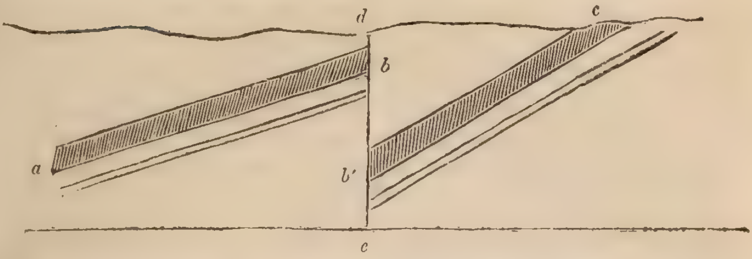
"The *relative positions* of the stratified and unstratified masses is such that, as a general rule, the former reposes on the latter. Near their surfaces of junction, however, they are frequently dove-tailed, as it were, into each other, by veins of the unstratified mass which penetrate into the stratified portion. In other cases, vertical *dykes* rise like walls through the strata; and, in almost every mountainous district, similar rocks are found either in large irregular masses, or regularly interstratified between the beds of stratified rock. These facts are highly significant as indicating the primitive state of the unstratified mass.

"The *positions of the strata* of the stratified mass next demand our attention. We have spoken of them as being in general approximately horizontal; but in numerous instances they deviate more or less from this position, the deviation being more general in the older strata, and usually the greatest in mountainous districts, where the strata become not unfrequently nearly vertical. This inclination to the horizon causes each stratum to rise successively to the surface, and thus enables us to ascertain its mineral nature and organic contents. The angle of inclination is termed the *dip* of the beds. It not unfrequently changes from one direction to the opposite, several times within the limits of the same mountainous district, as shown in the annexed diagram, which represents a section in the direction of the dip. Lines through A and B perpendicular to the section are called *anticlinal lines*, and a similar line through C is called a *synclinal line*. Such lines will frequently be continuous and nearly straight for many miles, and often correspond more or less with the external character of the district, in some such manner as indicated by the diagram.



"It is this inclined disposition of the strata which enables us to form some rude estimate of the thickness of the whole stratified mass in particular localities. It cannot, in many places, be estimated at less than 20,000 or 30,000 feet, and may possibly be considerably greater. It is essential that the geological reader should realize in his own mind the enormous magnitude of the stratified and fossiliferous portion of the earth's crust.

"There is another kind of discontinuity to which these strata are subject, and which may also be best illustrated by a simple diagram. In these cases, the whole stratified mass has the appearance of having been dislocated along the nearly vertical planes *d e*, as indicated by the discontinuous stratum *a b b′ c*. This dislocation is called a *fault*. The



displacement *b b′* may not exceed, in some cases, a few feet, while in others it may amount to several hundred feet. In the latter case, the faults usually extend for many miles.

"These faults are intimately associated with large deviations of the strata from horizontality. They are almost invariably parallel to the neighbouring anticlinal and synclinal lines, which themselves observe the same *law of parallelism.* One of the most gratifying results of the labours of the field-geologist consists in this evolving of law and order amidst the apparent irregularity and confusion usually presented to us in the external features of a mountainous district.

"The complete evidence of the facts which we have now described in broad outline must, of course, be sought in the labours of geological observers. When the geological sense, however, is once awakened, we can scarcely cast our eye on a sea-cliff, a mountain-escarpment, or even a railway-cutting, without seeing evidence of some such facts as those above stated."

The general arrangement of the fossiliferous or stratigraphical portion of the earth's crust is then given, and a concise table of the general arrangement of the animal kingdom.

The latter we transcribe, as it may prove useful to some of our readers:—

Sub-kingdom *Vertebrata.*

Class Mammalia.
,, Aves.
,, Reptilia.
,, Pisces.

Sub-kingdom *Articulata.*

Class Crustacea.
,, Arachnida.
,, Insecta.
,, Anellata.
,, Cirripedia.

Sub-kingdom *Mollusca.*

Class Cephalopoda.
,, Gasteropoda.
,, Pteropoda.
,, Lamellibranchiata.
,, Branchiopoda.
,, Tunicata.

Sub-kingdom *Radiata.*

Class Radiaria.
,, Polypi.
,, Entozoa.
,, Infusoria.

The first of these sub-kingdoms consists of animals of the highest organization—the last contains those of the lowest. The Articulata and Mollusca are arranged side by side, as having something like an equality of pretension as regards their organization. The last class of either of these sub-kingdoms has no claim to be ranked above the first class of the other. They cannot, therefore, be arranged in linear order. Of the Vertebrata, the mammals, the reptiles, and fishes abound; the remains of birds, as might be expected, are more rare. Of the Articulata, crustaceans (now represented by crabs, lobsters, &c.) are in considerable numbers, comprising the various extinct genera of Trilobites which characterized some of the oldest formations. Among the Mollusca, the Cephalopoda (now feebly represented by the cuttle-fish, &c.) were formerly abundant, comprising large Orthoceratites and other similar forms, with the numerous genera of Ammonites, of which the general form will doubtless be familiar to most of our readers. Gasteropoda (univalves), and Lamellibranchiata and Brachiopoda (bivalves), are exceedingly abundant, as might be expected, on account of the facility with which their shells would be preserved. Brachiopoda are especially abundant in the older formations. Also fossil Radiaria, Polypi, and Infusoria abound.

"The highest classes found in the Cambrian beds (as above defined), are Crustacea and Cephalopoda, with numerous fossils of lower classes. In the Silurian division, a few fishes appear, in addition to the lower classes of animals, of which, however, the *species* are for the most part changed. In the Devonian beds, fishes are very abundant, and reptile-life also makes its appearance. In the coal-formation, plants first become abundant. The Lias abounds in enormous reptiles; and in the Lower Oolites (Stonesfield slates) the first mammals* (small marsupial animals) appear. In the Tertiaries, large mammals abound, and finally Man was introduced. This recent introduction is proved by the fact of no human bones having been yet discovered in a fossilized state. Of all the *species* of animals now living, it is believed that none are found fossil, with the exception of a few in the most recent tertiary beds."

The author's first proposition, then, is—"*that the stratified beds were deposited from water*, and in the same manner as that in which we may so frequently observe earthy sediment to be deposited, after being held for a certain time in mechanical suspension in that element. If this deposition take place at a uniform rate, and the matter deposited be always of the same mineralogical character, there will be no *stratification* of the deposited mass; but if the process be discontinuous, or the matter deposited should be at one time, for instance, argillaceous, and at another, arenaceous or calcareous, distinct beds superimposed on each other will be the necessary consequence, and the mass will be stratified, as we actually observe the stratified portion of the earth's crust to be."

The next proposition is, "*that the matter which formed these beds, consisted of extremely fine sediment, very slowly and gradually deposited*, as shown by the preservation of delicate organic structures. Such beds are termed *sedimentary*, a term frequently also applied to the whole stratified mass, on account of the general predominence of this character. There are some beds, however, which consist principally of rounded pebbles, or other masses of various sizes, which must have had their present forms when first arranged in the existing beds, for it is inconceivable how their forms could have been derived from the subsequent action of any physical causes. These masses, which could only be spread out by comparatively violent action of water, or other powerful agencies, seldom contain organic remains at all, and never those of a delicate structure, in perfect preservation."

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* Still earlier, though very rare remains of small mammals, have been met with in the Triassic beds of Germany and Carolina.—Ed. Geologist.

The physical causes concerned in the production of these sediments very naturally occupy the next place in our author's essay. The great cause, whether due to the action of the atmosphere or of the waters of the globe, is that degradation of the dry land and its shores which geologists include under the term *denudation*. Before a current of water can put down a quantity of matter, it must manifestly take it up; and, moreover, as water cannot while in a tranquil state either take up matter or hold matter, however finely divided, in mere mechanical suspension for any length of time, it follows "that the operations of denudation and of deposition may be regarded as simultaneous operations, the rate of one being an almost exact measure of that of the other. Consequently, since we have shown that the rate of deposition must have been slow, we conclude that the rate of denudation must have been equally so."

The causes assigned for the denuding operations are the waves and tidal currents, the exhalations of vapour by solar heat and its condensation in the form of rain—causes co-existent with the moon, the ocean, and the diurnal rotation of the globe; for so long must the tides and the tidal currents of the ocean and atmospheric changes have been at their unceasing work of abrasion and conveyance of the abraded matter to lower levels.

"It may, perhaps, be supposed that the double process of denudation and deposition which we have been discussing may have been effected in former periods with greater rapidity by the aid of those great convulsive movements of the land to which many geologists are disposed to refer the apparent dislocation and highly inclined positions of so many sedimentary beds. We may doubtless conceive repeated processes of demolition, transport, and deposition of large quantities of matter to have taken place in this manner by paroxysmal efforts; but this sudden deposition of materials in large quantities could never form regularly stratified beds, or admit of the regular distribution of organic remains throughout the deposited mass;" such tumultuous transport being utterly different from that which accompanied the deposition of the ordinary sedimentary beds; and, exceedingly slow as these abrading and remodelling processes *now* are, there is no reason for supposing them to have acted with greater vigour in geological periods."

Having thus dwelt on the origin and manipulation of the materials forming the stratified crust of the globe, the author follows on with observations on the *manner* in which these strata were deposited, namely:—"*That the original position of these sedimentary beds was very approximately horizontal.*" He afterwards discusses the nature of those operations which have effected the marked changes between their actual and their original positions.

Then follow the various propositions:—1st. "*That most of these beds must have descended very slowly after their formation, beneath the level at which they were deposited*;" and as an auxiliary to this proposition, "*That every area of long-continued deposition must have been an area of slow continuous depression. That by far the greater portion of the earth's surface which now constitutes dry land must have been raised above the level at which it was originally formed.*"

In many cases, such descending movement must demonstrably have preceded the ascending. For on reference to the preceding diagram (fig. 8) it is easily seen that the edges of the strata which are, in a geological sense, the lowest in the series, are actually found at the greatest height above the sea-level,—often as much as 8,000 to 10,000 feet, and even to 15,000, as in the Himalaya mountains; but these same strata, if they have a sufficient aggregate thickness of strata above them belonging to the higher part of the series, must, from what has been already proved, have gradually descended from their original position during the deposition of the superincumbent beds.

Mr. Hopkins anticipates the very natural question: "But what physical causes can be assigned of sufficient mechanical energy to produce these mighty movements?" and replies that modern volcanic eruptions indicate the former existence of adequate power in the intumescence of fluid lava produced by the expansion of elastic gases within it.

(To be continued.)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Pyritiferous lignite, and its applications—A Diamond which has turned out to be a Topaz—The metal Cerium and its compounds—Waters of the Bay of Vulcano at Santorino—Palæontology in Southern Russia—Errata.

At the last meeting of the *Société Impériale d'Horticulture*, at Paris, M. Millot-Brulé, an agriculturist, presented to the members of this institution a dark-coloured earth, which he had employed with success, he stated, against the attacks of grubs, snails, &c., in gardens or plantations. By scattering a small quantity of this earth around any plant, the approach of slugs, or the larva of insects, &c., was rendered impossible. This was proved by experiment before the meeting, by placing some slugs and larvæ of cockchafers upon a damp plate of glass and surrounding them with a circle of the black earth. Not a single one could make its escape, and pass out of the circle; and when the earth was sprinkled upon them, the animals soon died. Experiments were also tried, with similar success, upon the cryptogamic vegetation which constitutes the disease of the grape. Vines that had suffered remarkably from the ravages of the *Oidium Tuckeri* were restored to health when besprinkled with this black earth, more effectually than if sulphur had been employed.

The members of the *Société Impériale d'Horticulture* seemed puzzled not a little as to the nature of this earth; M. Payen, the distinguished chemist, who was present at the meeting, insisted that sulphuric acid had been mixed with it, and that this was the cause of its insecticidal and fungus-destroying properties. M. Millot-Bruté denied having added any acid whatever. The next day the earth was sent to me to be examined.

It consists of a friable black lignite, intimately mixed, in its natural state, with white iron-pyrites (*Sperkise*). I have frequently had occasion to observe it in Picardy, in certain deposits belonging, I believe, to the Subapennine formation, or the *terrain de la Bresse* of Beudant,* and I know that it has been seen in the vicinity of Paris, where it contains a considerable quantity of pyrites. (The specimens of M. Millot-Bruté were taken near Rethel, in the Ardennes.) In the year 1856 the Count de la C——— brought to me a quantity of pyrites extracted from these lignite-beds, near Paris, inquiring whether anything could be done with them, as they existed in considerable quantities, he said, at the very gates of the capital. The pyrites is of that description called Sperkise, which, by contact with damp air, rapidly absorbs oxygen and becomes sulphate of iron. Earlier in the same year (1856) I had visited, with Professor Koene, of the Brussels University, the large manufactory of sulphuric acid belonging to M. Vander Elst, of Brussels. I observed that Sperkise was employed in this manufactory instead of sulphur.† This Sperkise is obtained from the tertiary clays of Boom, on the little river Ruppel, in Belgium, whence it is known as *la pyrite de Boom*. The pyrites of the lignite-deposits mentioned above is almost identical with the latter; I therefore endeavoured to ascertain if it would not be profitable to use the pyrites of the lignite in the manufacture of sulphuric acid at Paris, but M. de Sussex, director of the Javel manufactory, seems convinced that it is cheaper to buy sulphur. This may be the case at Paris, but it does not follow that it would be so for other localities.

In Picardy the organic deposits to which allusion is made in this paper are found, I have said, in some of the more recent alluvial formations, but a compact lignite, which is sometimes used as a combustible, exists in many parts of the province; for instance, at Albert, where it forms long black bands, or seams, in the white chalk, it is extracted, and burnt for the ashes which are employed in agriculture as manure, &c. In the alluvial beds the lignite is friable and pulverulent; it contains a considerable quantity of Sperkise, and is also employed by agriculturists, either in its natural state, when it is called *Cendres noires*, or after undergoing spontaneous combustion, or calcination (*Cendres rouges*). It is, doubtless, a valuable manure; for, as before stated, the pyrites it contains is easily transformed, by moisture and air, into sulphate of iron; and sulphate of iron will fix ammonia in the same manner as does sulphate of lime—a proverbially efficacious manure.

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* Geologie, p. 249.

† This is often the case in countries where pyrites is common.—T. L. P.

Moreover, I am convinced that this formation of sulphate of iron by the pyrites in contact with the atmosphere determines also the production of a certain quantity of carbonic acid gas at the expense of the organic elements of the lignite. So that, besides the insecticidal properties recognised by M. Millot-Brulé, and its efficacy as a remedy for grape disease, this black earth will furnish to plants the two principal elements of their nutrition, namely, carbonic acid and ammonia.

We will add, in conclusion of this subject, that the friable, pulverulent lignite impregnated with pyrites, of which we have been speaking, has been applied with success by Dr. Apelt, under the name of *Schwefelkohl*, to preserve timber, more particularly that employed in railway-constructions.*

About a year and a half ago, a precious stone, supposed to be a diamond, weighing nearly 25 ounces, or 819 carats, and which was valued at some millions of francs, was brought from the Brazils to Europe. It was cut in the form of the "Regent;" its height is 43 millimetrès, its diameter being 53 millimetrès. A mineralogical consultation has been held on this stone at Vienna, and M. Haidinger, who formed part of the commission, has just published the result of this inquiry:—The pretended diamond turns out to be a topaz, having the double refraction, the specific gravity, the hardness of ordinary topazes, and being worth simply (as a curiosity) from 225 to 250 francs, or about £10. It appears also that M. Elie de Beaumont was of this opinion when he first saw the new Brazilian stone, about eighteen months ago. The following are the characters M. Haidinger assigns to it:—

It is perfectly transparent, having the dimensions and weight mentioned above, and possessing a slight blue tint. Being a transparent substance the phenomenon of simple refraction would have immediately indicated a diamond or an artificial stone—double refraction would have led to the supposition that the stone was quartz, white beryl, or topaz. M. Haidinger assured himself that the Brazilian stone possessed double refraction, and that its specific gravity was 3·57 (that of the topaz has been given by some authors 3·56); its hardness was also proved to be precisely that of the topaz, for the two minerals, when rubbed together, scratched one another. There exists, therefore, no doubt that this Brazilian stone is a fine topaz.

The salts of the metal called Cerium, which up to the present time has only been discovered in a few of the rarer species of minerals, have lately been found by Messrs. Damour and H. Ste-Claire Deville, to constitute a good and delicate test for recognizing the presence of phosphoric and arsenic acids. It was observed that an acid solution of any phosphate will produce a voluminous precipitate, of a white or yellowish colour, with acid solutions of either sulphate or nitrate of cerium. Arseniates act in the same way.

This is rather important to mineralogists, as it procures them an easy method of recognizing the presence of cerium in minerals. For, if acid salts of cerium can be employed with advantage to detect phosphoric and arsenic acids, the latter, or their acid salts, may naturally be used to detect the compounds of cerium. It will, perhaps, be found, in course of time, that cerium, a metal which, by its chemical properties, resembles iron in many respects, is not so scarce in nature as we have hitherto been led to suppose.

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* Dr. Apelt's process has been described in our Paris contemporary *Le Cosmos*, t. iii. p. 141 *et seq.* where it was inserted on the demand of Baron Alex. von Humboldt.—T. L. P.

A short time ago we read in the *Courier de Paris* something to this effect:—"For some time past the waters of the little bay of Vulcano, at Santorino, have been spoken of as having the property of cleaning the copper-sheathing of vessels; but this precious quality has not been made use of so much as we should have expected, and since the year 1821 the bay has been almost abandoned by ships. Lately, however, experiments have been made to prove the fact anew; the *Solon*, a screw-packet-boat, stationed in the Levant, received orders to go to Santorino and remain some hours in the Bay of Vulcano. Although coated with many layers of red-lead, the iron keel of the *Solon* had collected and fixed an endless number of shells, sea-weeds, zoophytes, &c., so that its course had been notably impeded. But after a short delay in the Bay of Vulcano these shells and seaweeds were detached with ease by the aid of a brush, and a knot an hour more was immediately gained in speed. Three other French ships and two English brigs followed the example of the *Solon*, and these had coppered keels. The effect was the same on all, and no less surprising than agreeable to the captains of the vessels."

The cause of this may be thus explained: In recent times a submarine island made its appearance within the crater of Santorino*. In 1810 it was still 15 fathoms below the surface of the sea, but in 1830 it had risen to within three or four. It rises steeply, like a great cone, from the bottom of the sea, and the continuous activity of the submarine crater impregnates the surrounding waters with sulphurous and sulphuric acids. The coppered bottoms of ships lying at anchor for a short time in the Bay of Vulcano are cleaned by the acid produced in this natural volcanic process.

M. de Nordmann, of Helsingford, in Finland, a naturalist distinguished by his scientific expeditions into Caucassia and the Crimea, has just terminated the first two parts of a great work upon the Pælontology of Southern Russia (*Paléontologie de la Russie Méridionale*). The exploration of certain rich fossiliferous deposits that he found near Odessa and in Bessarabia has enabled M. de Nordmann to make some interesting and important discoveries. His first paper is really a treatise upon fossil bears. To those already known he adds a new variety, *Ursus spelæus Odessalus*. He proves, by many and varied considerations, that the fossil *Ursus spelæus* differs essentially—as Cuvier always affirmed, in spite of the contrary opinion upheld by De Blainville—from the existing bear, *Ursus ferox*. In the second memoir are described and figured (the drawings being made by the author himself) a great number of fossil quadrupeds belonging to the genera *Felis*, *Hyæna*, *Canis*, *Mustela*, *Equus*, *&c*. Among them *Canis meridionalis*, different *Solipedes*, and a certain number of Rodents are entirely new species. Judging from what the papers say, M. de Nordmann's journey to Russia seems to have opened to him a vast field of observation concerning living and fossil bears.

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* For a figure of this remarkable island and some adjacent ones, see Beudant, *Geologie*, p. 31.—T. L. P.

Errata.—The printer, who, in my article for July, made me say that boric acid was discovered in 1872 (instead of 1772) has, in composing the type of my last contribution to the Geologist (at page 396, 4th note), made me affirm that "Topaz contains mica," &c. The note should be, "Topaz, certain micas," &c., or better, "certain varieties of mica."

GEOLOGICAL MANIPULATIONS.

NOTES ON MAKING GUTTA-PERCHA MOULDS AND PLASTER OF PARIS CASTS.

By T. Rupert Jones, F.G.S.

(*To the Editor of the* Geologist.)

My dear Sir—As something towards enabling amateur and other geologists to communicate some of the results of their researches to their fellow-inquirers, I beg to offer the enclosed directions for making a preparation of gutta-percha and bees-wax, much better adapted for taking casts and moulds of fossils than gutta-percha itself; and also some useful remarks for the preparation of plaster-casts. These directions have been chiefly drawn up, at my request, by my friend, Mr. John Wetherell, of Highgate. I have also to observe that the prepared gutta-percha is capable of being applied to the purposes of the museum in another way, which has been suggested to me by a friend lately. Thus, have some narrow slips of tin folded into squares, of convenient sizes, and into these press some of the composition, and use these as pedestals for such fossil shells, and other specimens, as will not stand steadily by themselves. By warming these pedestals in hot water, they are readily softened so as to receive the fossils when pressed into them, and the latter can be at any time raised for examination.

Of course this composition, or even gutta-percha itself, is unfit for use in hot climates, and for transmission, by post or otherwise, to the tropics.

1. *Preparation of the gutta-percha*—Procure a moderate-sized pipkin, into which put some bees-wax, place it on the fire, and allow it to melt (without boiling). Some fine cuttings of gutta-percha, which must be free from any foreign substance, are then to be thrown into the pipkin, in the proportion of about four of gutta-percha to one of wax. The melted mass is then stirred up with a large metal spoon, until it is thoroughly mixed, free from lumps, and of an even colour. It should then be taken off the fire, and poured into a basin of warm water, to prevent its cooling too rapidly. In a few minutes it may be made by hand into convenient lumps for keeping.

2. *Making a gutta-percha mould or cast*—The prepared gutta-percha, above alluded to, is put into a saucepan of hot water—not boiling, as that would make it too sticky. After remaining a short time, it may be taken out, and the softened part separated by the fingers, which should be kept moist to prevent the mass from sticking to them. This must be repeated until you have sufficient to cover the specimen which has to

be operated upon with a thin coating, not exceeding the sixteenth of an inch. Having obtained a smooth even surface of the gutta-percha, warm the specimen by dipping it into warm water, or otherwise, and cover it with the preparation. It is advisable sometimes to wet or oil the specimen previously to putting on the gutta-percha, to prevent it adhering. It must now be well pressed on the specimen, in order that it may delineate the more delicate structure, and this manipulation must be continued until it becomes hard; then remove it from the specimen, or, if necessary, cut it with an oiled knife. Previous to cutting, marks should be made, to ensure the mould being correctly joined in taking the plaster-cast. It is desirable to make a small hole in one of the pieces, to allow the plaster to be poured in.

3. *Making the plaster-cast*:—Sprinkle the plaster into a basin containing water enough to fill the required mould. Mix it well until it forms a thick paste; it is then fit for use.

Take the pieces of the gutta-percha mould, and join them by means of India-rubber bands, exactly according to the marks previously made. A small quantity of plaster is then poured into the opening, and the mould is turned round several times. This must be done quickly, as the plaster dries very rapidly. More plaster is added until the mould is full. It is then left for a few minutes to set. The mould is then taken off, and well cleaned, to be ready for another casting. The tools should be put into water immediately after using them, to prevent the trouble which otherwise arises from the hardening of the plaster.

In taking a plaster-cast from a large open gutta-percha mould, after carefully oiling the surface of the latter, the moist plaster should be first poured on in a fluid state, and carefully and quickly worked into all the irregularities of the surface by means of a stiff brush; a shortened "painter's tool" is best for the purpose; and the plaster subsequently added should be cautiously and continuously jogged, holding the mould between the hands, and knocking its base on the table with steady, slight successive blows, so as to ensure the bubbles of air leaving the mould, and rising to the top of the plaster, as long as it is fluid.

It is often advisable to place the ends of a piece of folded string in the soft plaster whilst making the cast, to supply means of pulling at the cast to release it from the mould.

London, August 23rd, 1858.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

East Kent Natural History Society.—The East Kent Natural History Society held their annual meeting on the 28th of August, and selected Dover as their head-quarters upon the occasion. The Association has been in obscure existence some years, but appears to have been lately revived with great vigour, and we hope will long continue to labour earnestly and well in a district in which much as has been done, so much yet remains to do.

The arrangements of the day comprised the double attraction of an excursion in the morning and a dinner in the evening; the scene of the first portion of this programme being the coast lying between Folkestone and Dover. The gathering was further favoured by splendid weather, and by every other external circumstance which could contribute to ensure its complete success.

Mr. Mackeson, of Hythe, acted as the scientific teacher of the party throughout the excursion.

On arriving at the brow of the Undercliff, near No. 3 Martello Tower, he commenced his address by explaining what was meant by the Cretaceous Formation, viz. :—A series of beds distinguished by very distinct lithological characters, but forming a natural group when considered with reference to their fossil organic remains. This formation is sub-divided by geologists into,

1. The Chalk;
2. The Upper Greensand;
3. The Gault;
4. The Lower Greensand;

as was illustrated by a diagram, representing the section from Folkestone Hill to Copt Point, displaying this order and superposition of the beds.

The Upper Greensand, here very feebly represented, was first examined. In a westerly direction, as at Merstham, in Surrey, and in the Isle of Wight, it forms a bed of considerable thickness, containing numerous fossils; but here it appeared to have all but thinned out, its thickness probably not exceeding three or four feet, and its fossils being few and far between.

Descending to Copt Point, that unrivalled section of the Gault with its numerous interesting fossils, was dilated upon; particular attention being drawn to the state in which the shells of *Ammonites*, *Hamites*, *Inocerami*, &c., are there preserved. The estimated thickness of the Gault is about 120 or 130 feet.

Taking up a position on the out-crop of the Lower Greensand, Mr. Mackeson explained to the members that the history of this interesting group of sands and clays could not be fully entered upon, inasmuch as only the uppermost of its four subdivisions offered itself to their notice within the range of the day's excursion. Examples of false stratification were explained, and the innumerable traces of large sponges on the rock-masses pointed out. The prominence of the Copt Point was due to the resistance of the Greensand Rocks to the action of the waves. The junction of the Lower Greensand and Gault, there visible, proved the beds to be conformable, and was the subject of numerous remarks, and the profusion of coniferous wood thereabouts, often bored by Teredos, was adduced to prove the existence of contemporaneous pine-forests, which must have grown on land then above the level of the ocean.

The phosphate of lime-nodules abounding in this junction-bed are by the aid of the chemist's "magic art," valuable to the agriculturist, after manufactureinto super-phosphate of lime.

The existence of these nodules here was first remarked many years ago by that veteran geologist, Dr. Fitton; and in a lecture at Folkestone, in 1847, their abundance and mercantile and agricultural value was pointed out by the present editor of the GEOLOGIST.

Passing along the shore in the direction of Dover, the lecturer drew the attention of the members to a conglomerate of shingle and lime, concreted by the springs flowing from the chalk, holding carbonate of lime in solution. The universal use of artificial concrete at the present day gave an additional interest to this—Nature's own work—in which the matrix of lime was scarcely less indurated than the included pebbles of flint.

A halt was called near the Pelter coast-guard station, where the lecturer explained how the beautiful undercliff extending under the white and beetling chalk-cliffs from Copt Point to this spot was due to the waste of the lower and softer beds by the sea, and the consequent downfall of the harder superincumbent chalk-strata.

Mr. Mackeson here threw a hasty glance at the geology of the Bas Boulonais as intimately connected with that of the south-east of England, and alluded to the occurrence of the true Coal-measures at Hardinghen, near Boulogne, the possible continuation of which across the Channel was pointed out shortly since by Mr. R. A. Godwin-Austen in a most valuable paper before the Geological Society, London, and which proved the possible occurrence of coal at no vast depth within the area of the Wealden elevation. Mr. Prestwich's paper on the boring for water at Harwich, read before the same Society, contained facts in confirmation of this view.

The chalk was next described by the lecturer, with its division into Upper, Chalk with flints, Lower, Chalk without flints, and Grey Chalk. Mr. Mackeson concluded his remarks by a reference to the river-system of the south-east district of England, showing by diagrams how the rivers Stour, Medway, Darent, all rising northwards of the chalk-range, traverse valleys in the chalk, and deliver themselves at the northern part of Kent, instead of, as might have been expected, taking their course through the valley of the Weald, or through Romney Marsh. The rivers of the South Downs, the Ouse, &c., were shown to pierce the chalk hill-range by corresponding cross valleys.

The lecturer illustrated his remarks by diagrams of the geographical distribution of the Cretaceous formation, and by a section of the coast from Beachy Head to Dover, illustrative of the theory of the elevation of the Weald. In the course of his observations, the lecturer expressed his deep sense of personal obligation to Dr. Fitton, whose papers, in the Transactions and Journals of the Geological Society, were models alike of sound reasoning and correct observation.

The members of the Society dined together in the great hall of the Maison Dieu, at Dover. At one extremity of this building were arranged various kinds of bee-hives, models of the comb, and of other objects connected with the honey-bee; cases of butterflies; and other objects suited to the tastes of a Natural History Society. The party consisted of between fifty and sixty ladies and gentlemen.

After dinner, Major Munn made some observations on the subject of the Honey Bee.

Mr. Roberts then proceeded to read a paper on the Teredo, or boring worm.

The Rev. Mr. Scott read a paper, which had been drawn up by the owner of an owl and of a common cock, giving a somewhat amusing account of the hatching of the honest barn-door fowl by the unfriendly bird of night. The birds had both been stuffed, and as they were produced in this condition they gave some additional point and interest to the reading of the paper.

NOTES AND QUERIES.

Mammalian Remains.—Sir,—In a very large excavation in the gravel at Ballingdon, Essex, remains of fossil Mammalia have been found at intervals during the last twenty-five years, and during the last few months highly interesting remains of rhinoceros, elephant, deer, and horse, have been met with in the course of obtaining gravel for the roads. A list of these remains I now beg leave to lay before the readers of the Geologist, should you deem it acceptable.

Rhinoceros.—1. A humerus, nearly perfect.

Elephant..—1. An upper-jaw tooth, having 21 laminæ in a space of 9½ inches across the laminæ from back to front.

2. An upper-jaw tooth, with 19 laminæ in a space of 7¾ inches from back to front.

3. A lower-jaw tooth, having 14 laminæ in a space of 4½ inches only across the laminæ (much worn); this appears to have belonged to an aged animal.

4. A large portion of tooth of upper-jaw, with 11 laminæ in a space of 5 inches across the laminæ.

5. A smaller portion of tooth, having 15 laminæ in a space of 5½ inches across the laminæ.

6. A detached lamina, the other portions lost.

7. A lower jaw tooth, much worn, like No. 4 in this list. This tooth is now in the British Museum.

8. Another fine tooth from the gravel was presented to a lady in the neighbourhood.

Deer.—1. Metatarsal, nearly perfect.

Horse.—1. Tooth of upper jaw,
2. Tooth of upper jaw, } These teeth are more curved than recent teeth.
3. Tooth of lower jaw.

These fossils are in the cabinet of the proprietor of the estate on which they were discovered. In the year 1856, a fine tusk of elephant was taken out of the same gravel; curved rather more than half a circle, measuring seven feet on its outer curve, three feet of the hollow base being wanting. It was seven inches in diameter at its proximal end, and nearly 4 inches in diameter at its distal extremity. This fine fossil tusk is now in the Sudbury Museum.

The gravel in which the above and many other mammalian fossils have been discovered belongs to the Boulder-Clay formation. And in it the boulders of nearly all known British rocks may be recognized, especially those which are sufficiently hard to have survived the transit hither, such, for instance, as the various sandstones, and the hardest of the Oolites. Here we meet with boulders and angular blocks of the calcareous grit of the Heddington quarries, near Oxford; others very much like the forest-marble, and inferior oolite, greensand, and an abundance of hard chalk; some of these fragments are angular, while others are perfectly smooth and rounded.

The matrix in which these minerals and organic fossils are embedded is, in one part of this extensive detitral deposit, a greyish sand; at others a yellowish clay, of which bricks are made.

This interesting deposit of boulder-clay and gravel assumes a thickness here of from 30 to 40 feet on the right bank of the river Stour as we descend that stream, and continues for several miles to the pleasant little town of Bures St. Mary, forming small abrupt hills and valleys with beautiful undulations.

There is not perhaps a detrital deposit in England where a greater variety of fossils might be obtained than where the above mammalian remains were found.

Yours truly,
Stanway. JOHN BROWN, F.G.S.

NOTE ON EARTHQUAKES, BY JOHN CALVERT, F.G.S., C.M.E., &c.—Shocks of earthquakes are of such frequent occurrence in the West Indies, and tropics generally, that few residents make any close observation or record of those awful phenomena. At the same time, the houses being for the most part built of wood, the immediate personal danger cannot be considered an ordinary excuse. During a residence of several years in Jamaica, I witnessed so many that latterly I became more sensible of their approach, and was the better prepared to observe their effects. The most fearful shock I witnessed was in 1852, about ten o'clock p.m.; I was standing at a drawing-table, when I became suddenly sensible of its approach by the peculiar and indescribable feeling of faintness and despondency that is invariably the precursor or physical effect of them; and in an instant I found my ruler rolling towards me, which as soon took the opposite direction away from me. The pictures on the wall swung to and fro six or seven times, at intervals of about two and a-half seconds; the glasses jingled on the sideboard. The horses and cattle pasturing round the house stumbled and ran about visibly affected; the blood-hounds in the house growled, and distended their legs, sliding on the brilliantly polished floors; even the poultry gave evidence of their excitement. The negroes fell on their knees to supplicate protection, and all creation seemed to be made instantaneously sensible of that Divine power that "weighed the mountains in scales, and the earth in a balance." I felt like the ant, whose industry I have often watched, and with the stamp of my foot shaken in an instant the labours of millions level with the earth. From my memoranda at the time, my impression then was, that the peculiar sensation felt in the first instance originated in the elevation of the ground, from some internal power, and that the "undulations," as they are usually termed, were the gradual subsidence or settlement, first on one side and then on the other; for on comparing notes with friends in various parts of the island, I did not find that it travelled in "waves," as some persons describe, but was felt at the same time. This observation must, however, be qualified by the fact that every one had not a watch handy, or if they had there might be a variation in them. But I certainly never found any *positive* foundation for the supposition of the undulations *travelling*, but considered them local. It seemed to me more like a sudden rising of a crust of earth, so to speak, and a gradual subsiding of it afterwards, first on one side and then on another. For I observed in something hanging to the wall before me that the undulations made it swing on the wall first, but after it swung *to* and *from* the wall. These movements were usually *accompanied* by a rumbling sound, not before or after; and on the occasion I mention, the earth opened some hundred and fifty yards, two feet wide, and never closed, but I observed no emission therefrom, or peculiar appearance of the soil. It appeared like what it probably was, merely a crack occasioned by the settlement of the ground *after* the earthquake. There was a peculiar oppressiveness in the air for days previous and after; I did not notice that the air was relieved of the oppression by the earthquake. Most of the large buildings were cracked in various places, and all more or less out of the perpendicular from repeated shocks. I will close this with a remark that geologists generally consider the submersion of Port Royal during the earthquake of 1692, was caused by the slipping down of the sand on which the town was built from the limestone rock that doubtless forms the nucleus of the peninsula, or, as it is termed there, the "Pallisades;" in favour of which supposition is the fact, that the foundation of some of the buildings are distinctly visible below water when the sea is calm, and a buoy marks the remains of the old church. On the opposite shore, "Green Bay," the sand seems to have shifted also since, for numerous tombs, some of once costly sculptured marble, are washed by every tide. But one of the most distant from the sea, almost inaccessible for the prickly cashars bush, covered by a slab of black marble (the most durable material I ever met with for the purpose) as good as when built there on its brick foundation,—excepting a few chips which some Englishmen could not resist breaking off even a *sacred* memento,—offers the following record of its occupier and the earthquake of 1692: "Here lies the body of Lewis Galdy, who departed this life at Port Royal, 22 December, 1739, aged 80. He was born at Montpelier, in France, but left that country for his religion, and came to settle in this island, where he was *swallowed* up in the great earthquake in the year 1692, and by the providence of God, was, by another shock, thrown into the sea, and miraculously saved by swimming, until a boat took him up. He lived many years after in great reputation, beloved by all who knew him, and much lamented at his death."

THE WALLED LAKES OF THE WEST.—In the generality of the notices of the curious phenomena of the boulder-walls of some of the lakes of North America, they have been regarded by antiquarians and ethnologists as artificial productions; the following letter in the *North American Gazette* on their origin from Prof. Edw. Daniels, the State Geologist, will be read, therefore, with some interest as showing they are due to the natural joint action of ice and water:—

"MADISON, April 25.—I have just read the notice of a *Walled Lake* in Wright County, Iowa, to which you called my attention. I recognize in the description a phenomenon common in the north-west, though perhaps rarely exhibited as perfectly as in the case here stated. Walls similar to that described occur around many of our lakes, and around marshes which have been lakes at a comparatively recent period.

"Those walls are usally composed of boulders and exhibit varying degrees of regularity, from confused heaps of rock to the compact structure and appearance of an artificial wall. They are due to the conjoint action of those potent agencies, ice and water, acting upon the drift-formation, which is always found where those walled lakes occur. Let us suppose a lake occupying a basin surrounded by banks of drift. Let it be understood that the drift of this region consists of attenuating beds of sand, gravel, and clay, intermingled with boulders. The action of the waves and falling rains upon the banks will remove the lighter and finer particles, from year to year, far into the lake. The boulders, commingled with the fine material, being heavy and difficult of transport, will drop down nearly at the points where they lie, and remain scattered along the margin of the lake.

"If, now, the lake be frozen, the expansive force of the ice pushes up everything moveable near the shore, and forms a ridge at the uppermost limit reached by the congealed water in expanding. This ridge will consist mainly of boulders covered by and mixed with sand, gravel, and the exuviæ of the shore. When the ice melts, everything but the boulders is soon washed away on the side of the ridge towards the lake; and the boulders are there exposed, forming a rough wall. Subsequent congelation crowd the boulders closer together against the bank or ridge, and render the wall more perfect. In this manner the lakes of Wisconsin, Iowa, and Minnesota have often become girt with walls having a very artificial character, properly referable to physical laws operating under peculiar circumstances.

"Several other lakes exist in our immediate vicinity, around whose shores the parallel ridges and lines of boulders mark the ancient action of the same causes. The third lake exhibits this agency very finely; and a very extensive marsh, including about 1,500 acres of bog and peat, ten miles west of this place, shows a very splendid specimen of this natural wall-building, several miles in length. This is Lake Menona, which forms the south-east boundary of our city. This marsh, like most other marshes, was the basin of an ancient lake, and the distribution of its boulders marks its outer limits. It is not uncommon for the ridges and walls to be pushed up much higher than the adjacent land outside. There is no difficulty in supposing, therefore, that the water in the lake might thus stand at a level above the land beyond the bank forming its barrier.

"I see nothing in the Iowa case that should constitute it an exception. In your minute observation in the West, you must have encountered frequent cases of this kind. EDWARD DANIELS."

To Geo. P. Delaplaine, Esq.

THE ENCLOSED FROGS.—"I have read with pleasure the interesting account of the frog found in the Dundalland colliery, ninety yards below the surface, by Mr. Wardlaw Ramsay, given at page 352 of the GEOLOGIST. It unfortunately appears that such discoveries are beset with difficulties, on account of miners being unprepared for the sudden appearance of living reptiles in the progress of their operations, or perhaps not having their interest sufficiently awakened as to induce them to notice the particulars of such occurrences. But surely this subject is sufficiently interesting and important to induce both the zoologist and the geologist to endeavour to ascertain the property by which frogs or toads are enabled to sustain life under circumstances in which they are excluded apparently from air and food. The late Dr. Buckland, as you, Sir, have observed at page 253, bestowed much attention to this very subject, and actually enclosed several specimens of the common toad in limestone; unfortunately, they all died after a short time. It has been observed that probably his experiments would have succeeded better had the creatures been taken directly from their natural habitats, instead of from the melon-pit in which they were kept previously to their incarceration in stone. In the "Magazine of Natural History," vol. III., new series, page 518, is an account of a toad being taken alive out of the ground, after being buried three feet below the surface in flint-gravel; having remained there undisturbed, under a small flower-pot, three years all but ten days. It lived three days after its removal from its dormitory. Another living toad was then consigned to the same three-feet-deep excavation, and, after full three years, was taken out of the ground alive from under the same flower-pot; this animal died eight days after.—"Magazine of Natural History," vol. X., page 180. Had the natural habits of these animals been better attended to after being taken out of the ground, they probably would have survived much longer. In the instances referred to no food was offered them after their long abstinence, neither was any care taken of them, as ought to have been done considering the importance of the experiments.—JOHN BROWN, F.G.S., Stanway."

FISH REMAINS IN BITUMINOUS-SHALE.—"DEAR SIR,—As many of your readers may not be aware of the interesting fossils contained in the coal-measures, I beg to intimate to such as reside in those districts that it will repay research to examine carefully the bituminous shale found associated with the true coal-seams. I have myself resided for many years in a coal district, and I had imagined that I was well acquainted with all the varieties of carboniferous fossils, but my knowledge was confined to the fossil flora merely, and I had no conception until recently that the bituminous shale was so rich in fish-remains. The beauty of the scales of many of them I cannot describe as I could wish, and I regret that no work with which I am conversant supplies the deficiency. The shape of a fish-scale is a very imperfect description of its beautiful markings, and of the great variety found in the fossil state. I can only allude here cursorily to the varieties found in this neighbourhood (Yorkshire), but a more careful revision may be hereafter given. The species I have met with comprise:—*Holoptychius*, *Megalichthys*, *Diplocanthus*, *Cœlocanthus*, *Ctenoptychius*, *Gyrolepis*, and some indications of an unknown species. In addition to the scales, numerous detached teeth, with a beautiful enamel still existant, are found, and instances of jaws with ten, twenty, or thirty teeth, are not uncommon. In some parts of the country entire fish are found in a fossil state, but this is not the case where I am located. I have thought it advisable to state these facts for the benefit of such of your readers as may have imagined, with myself, that the coal-measures were barren of interest, excepting as regards their vegetable remains which will always possess an interest in themselves : and, if these fish-remains should attract attention, I feel assured the trouble given by local geologists and collectors would be amply compensated. In conclusion I may be allowed to caution my readers not to give up the search for such remains in consequence of not finding them *instanter*. Some shales may be very barren of organic remains, whilst others, at a greater elevation or depth, may be rich in these interesting fossils.—Yours, &c., G. WILSON, Wakefield."

THE GEOLOGY OF LLANDUDNO.—"That 'Queen of Welsh watering-places'—as guide-books are pleased to style it—Llandudno, is such a fine field for geological enterprise, that I should like to hear of visitors taking as kindly to the *stones* as they do to its famed *plants*. A recent visit has given me something beyond the huge *Producti* and *Spiriferi* that take rank among collectors as the typical fossils of the promontory, and as the GEOLOGIST is taken in and esteemed by more than one 'Captain' of the mines there, I am glad to place my 'notes' in its pages. Good service in mineralogy has been already done by Captain W. Vivian, of Ty Glas, who, with the true spirit of an investigator of nature, assisted me greatly in the pursuit of that kindred science I was more specially interested in. The piled-up anticlines of the Great Orme gave me a range of life-remains of great interest. In point of size, the Brachiopodous shells aforesaid will still hold rank as the aristocracy of its fossil life ; but when in the course of a ramble over the 'Head,' their bed has been visited—it lies on the crown of the hill, N.W. of the Old Copper Mine—let the collector's walk be extended down the slope, that, leaving the telegraph on the right, leads to the sea, and let him notice the shale-bed that lies about six feet below his feet, and has been, in many places, broken into for the sake of its mineral contents. These are tiny nodules of green and blue carbonate of copper, but the bed in which they occur is little else than a mass of delicate fossils, exquisitely preserved through chalcedonization, and comprising the rarest and most beautiful forms of corals and sponges, Encrinites of several species, but chiefly *Rhodocrinus*, Brachipodous and Lamellibranchiate shells and many species of Gasteropoda may be picked out, not perhaps of the beds *in situ*, but from sundry mounds of 'rubbish,'—in mineralogical eyes, but which are treasure-houses of much value in geological ones,—lying at the foot of the sloping valley ; and out of which the nodular copper has been sifted. One only palatal tooth of a cestraciont-fish has yet been met with, an ordinary *Psammodus*. The physical geology of the whole district is well worth attentive study—not only in the unnatural elevations and crater-like depressions of the Great Orme, but in those yet more ancient volcanic disturbances that have raised the trap-hills between Llandudno and Conway. The igneous rock, in one range erupted through Lower Silurian sandstones, is filled with a Cyathophyllitish-looking coral (*Petraia rugosa*, I believe), altered by chemical contact with the molten mass. A line of basaltic outburst close to Maes Du, which has raised the shales to a vertical position, is not mapped by the government surveyors, so that the geological features of the district are not yet fully known. Altogether, there is fine work for geologic study about the Great and Little Orme, and such may be, in other eyes than mine, not the least advantage to be derived from a trip to Llandudno.—George E. Roberts, Kidderminster."

Disturbances in the Twelfth and Thirteenth Centuries.—"Nicholas Trevet, in his annals, states that in 1155, the first year of Henry the Second, 'Quintodecimo cal. Martii, terræ motu horribili facto in Burgundia absorptum est castellum quoddam juxta Cluniacum, et locus castelli repletus est aqua inestimabilis profunditatis.' Again, in 1248, the thirty-second year of Henry the Third, 'Temporibus Frederici, in Burgundia imperiali per terram solutam a montibus circiter quinque millia hominum suffocantur. Nam unus mons maximus, se dividens ab aliis montibus, per plura milliaria cujusdam vallis cadendo se extendens, ad alios montes accessit, omnes in valle villas terra et lapidibus operiendo.' Is the site of the castle still covered by water of unknown depth, and are any particulars known of the terrible landslip? Local tradition will doubtless have preserved some of the details.—John Jones, Gloucester."

Mammalian Remains.—"Dear Sir,—In pursuance of the request of Mr. Prestwich with regard to the fauna of the quarternary epoch, I beg to state that the Museum of the Isle of Wight, in Newport, contains teeth, scapula, and humerus of Elephas primigenius. They were found in a thin bed of gravel, beneath the brick-earth (five feet thick). The locality was a valley between chalk hills, one mile south of this town, in the line of the fault of the Medina. A similar stratum four miles north-east of Newport yielded an elephant's tusk—locality, valley of the Tertiary. Bones of the same animal, and others, are found in the drift overlying the Wealden beds at Brook and Brixton. Details can be had from, yours faithfully, Ernest P. Wilkins, F.G.S., Newport, Isle of Wight."

The Stratigraphical Catalogue of Fossils.—"Sir,—Whilst admiring the research and scholarship of Professor Morris' articles in your Journal, entitled 'British Fossils Stratigraphically Arranged,' I am surprised to find that in the list of the literature on the Silurian Rocks there should be no mention of the contributions of Hugh Miller. He has contributed to our science at least the following:—'On the Ancient Grauwacke Rocks of Scotland' (Old Red Sandstone, 8th edition, pages 297-324). 'On the Less-known Fossil Floras of Scotland,' Part 1, (Testimony of the Rocks, page 423). These pages referring to the Palæozoic Rocks are invaluable to us in Scotland; and in justice to the research and memory of one who has done so much for Geology, at least in our portion of the island, it is but right they should be recorded in any list, so complete in every way as that of Mr. Morris. I trust a long career of usefulness awaits your Magazine.—Yours &c., A Subscriber."

Manner of cutting Films of Selenite.—"Sir,—Would any of your readers who are acquainted with polarizing matters, give directions for cutting films of selenite of equal thickness to show a uniform colour throughout, suitable for placing on the microscope-stage, or for constructing those stars and other devices which are used with polarizing apparatus? The pen-knife seems only to separate unequal slips showing various colours and filled with a multitude of cracks.—Yours &c., G. Guyon, Richmond, Surrey.

Note on Central Heat.—"Sir,—The experiments of Arago, Cordier, Fox, Greenwell, and many other observers, have satisfactorily established the fact that the internal temperature of the earth increases in proportion to the depth descended, and that this increase may, most probably, be assumed as varying from 1 deg. Fahr. in 45 English feet, to 1 deg. in 60 English feet. Considering the various conductive powers of the materials of which the crust of the earth is composed, this is probably as near an average as can be arrived at. It would, however, from our general notions of the laws governing the diffusion of caloric, appear more natural that the heat should not increase directly as the depth, but rather as the square of the distance from the earth's centre. It is on this point I wish to make a note. If we take R for the radius of the globe, and x x_1 to represent the depth of two observations, we should have, assuming the law of the diffusion of caloric according to the square of the distance to hold good, the following expressions for the temperature of the two depths:—

$$R^2 - 2\,Rx + x^2$$
$$R^2 - 2\,Rx_1 + x_1^2.$$

Deducting one from the other we obtain

$$x^2 - x_1^2 - 2\,x\,R + 2\,Rx_1;$$

and remembering that x and x_1 are very small as compared to R (in the deepest mines about 1 to 12,000), and may, therefore, be safely neglected, we obtain for the difference of temperature the expressions

$$2\ R\,(x_1 - x),$$

which varies directly as the depth, agreeing with the best observations.—I am Sir, yours, &c., A. H. PATTERSON, Everton, Liverpool."

"FAIRY" CAVE IN SWALEDALE.—"An observation in your journal last month on the Caverns of Cumberland reminds me of a visit I made twenty years ago when on a mining expedition in the north of Yorkshire, where, after indulging in grouse shooting on the moor near Lowrow, in Swaledale, I was informed by some of my country friends that some miles beyond was a celebrated 'fairy cave.' I no sooner heard of it than I resolved to visit it, in spite of the report that no one ever returned from there that went in. This only made me the more determined to venture. Accordingly, I provided myself with a lantern, matches, and candles, a gun—revolvers were not made then—and the largest ball of cord I could purchase. On my road thither, accompanied by some 'country cousins,' I was met by several residents, who, on hearing my resolve, bade me a tearful farewell, after having increased my curiosity by their endeavours to frighten or dissuade me from entering. After winding along a sheep track on the side of a steep mountain for some distance, at the foot of which ran a mountain stream, I came upon a horizontal fissure in the limestone-rock about fourteen or eighteen inches high in the centre and several feet wide, or rather long. To enter was by no means easy; but, resolved, I fastened one end of my cord to a rock outside, lit the candle in the lantern, which I pushed before me, and crept in, *à la lizard*, dragging my gun, &c., with me. About twenty feet in the opening became wider, and after lighting another candle in case of accident, for no one would accompany me, I bid my friends wait outside till I returned, and climbed on through vast caverns glistening with pendent stalactites that reflected my lights a thousand times. Now I was going down carefully over loose clumps of rock, while the noise of waters rushing between them at my feet produced a slight feeling of awe. Curiosity led me first to one side then another; here I climbed to get through a small opening; there the roof of a large cavern some hundred feet long seemed studded with gems. I went down, clambered, turned to this side, and then the other, filling my "haversack" with what appeared fairy gems, and replenishing candle after candle from my lantern as the draft burnt them out. Every foot I proceeded found me some fine specimen which seduced me further on, sometimes even working my way on my belly through crevices not two feet wide, till at last I came to the end of my cord! And fortunate was I to have taken the precaution of that assistance—for, on turning round, I found nothing but *that* to guide my return, and as I kept hauling in to trace my way, wondered how I could have gone through places which, my excitement over, I dreaded to return. At last, by following my friendly cord, climbing and falling, in which I often extinguished my light, I reached the entrance which, but for the cord, I should never have found, or, if found, have recognized. I called to my friends outside, but no answer; I looked for light, but saw none. I became more than anxious; fired my gun, but no answer except from the lonely cavern. So 'lizarding' it again, I got out safe, and found my friends gone; I had been inside *five hours and a half*—they had shouted, pulled my cord till they feared to break it, fired guns, but at last, presuming the *fairies had taken me*, wended their way home, every one they met on the road sapiently remarking, 'We told you how it would be.' I returned, however, a few hours after my friends with an appetite that satisfied them, if I had been with the fairies, they had not supplied me with any substantial entertainment. I believe, then, this cavern had been an ancient lead mine, which, since disuse, had fallen in; but the friends I met then have years since finished their mundine probation, and I have had no inducement to visit again the 'Fairy Cave.'—F. G. S."

Volcanic Eruption at Guernsey in the Thirteenth Century.—The following extract may be of interest to the readers of The Geologist; the original is in quaint Latin:—Extract of a letter from Adam de Marisco, to Grossetête, Bishop of Lincoln, on the 7th of March of one of the years in the middle of the thirteenth century.—Translation: "What conjecturer can think what is the meaning of a prodigy, unheard of in past ages, made known publicly by the violence of fame in these days? Namely, that at the isle of Guernsey—a place bordering, as it were, on the two kingdoms of France and England—globes of fire are perceived to leap up very frequently out of the depth of the sea on to the eminences of the earth, devouring even the rocky masses and other materials with an irrepressible conflagration, and the inhabitants being driven away, after everything has been reduced to cinders, [the flames] conflicting fiercely with warlike encounters, [like] bands of armed people in the place of conflagration, and, after the conflict has ceased, withdrawing [themselves] into unknown retreats. Shall we then think that anything else is in question but that, while the wicked run mad, the elect lament, praying that these and other things unusual in our age, shown by the clement providence of the Supreme Lord of Ages, may be turned to good. I do not present myself as the author of this so wonderful novelty, but I recite what was reported in my hearing by a testimony above all exception." This is as much of the letter as relates to the volcanic eruption at Guernsey. I have translated it very literally, and word for word. You can mend the language if you like. I think it is the latest notice of any volcanic action in our islands.—T. Wright, *Sydney Street, Brompton.*

Transition Beds of the Chalk.—"A pleasant hours' walk from Beauvais brings the traveller to the open fields of Bracheux, and, in the old pit at the very summit of the hill, he will find a good development of the lower tertiary marine beds of Woolwich and Reading; another short hour brings him to the village of Laversines, where the usual upper chalk of the plateau is displayed. In an abandoned pit concealed by the trees of an orchard, close to the churchyard, accessible through some cottage gardens, lies a bank which has the appearance of earthy chalk, with yellow stains. This is a mass of sandy, calcareous earth, of limited extent, but well displayed. It lies evenly on the chalk, and rises to the surface in a knoll, covered with woodland. The upper portion is friable—the lower more compact. Fossils are extremely abundant; but principally as casts, badly preserved. The Astræa corals, spines of Cidaris, and casts of Arca, are extremely numerous. Mons. Graves, in his excellent work (Essai sur la Topographie Geognostique du Départment du L'Oise, 1847), gives a list of fifty-three determinable species, of which twenty-three are Maestrichtian, and only two found in the overlying white chalk. The impression derived from an inspection of the rich accumulation of debris is, that it constitutes the rubble-bed of a deposit; all other trace of which, in these parts, has been removed by the crowding and grinding action of the lower tertiaries; but how their mass of tender materials could have been protected from the forces which pounded up so much besides, it is difficult to conceive.—S. R. P."

Admission to the Geological Society of London.—"Dear Sir,—I should very much like to be a member of the proposed "Amateur Geological Association," and trust to hear much more about it in your next number. Would you also kindly inform me in what way gentlemen become Fellows of the Geological Society? In other words, what constitutes an F.G.S.—Yours thankfully, R A C - H A C., St. Ives, Hunts."—Fellows of the Geological Society of London are elected by ballot, after having been nominated by three Fellows, one of whom at least must have personal knowledge of the candidate. Resident Fellows (living within twenty miles of London) pay £6 6s. entrance-fee, and £3 3s. annually. Non-residents pay £10 10s. on entrance, and no annual subscription.

Contemporaneity of Denudation and Sedimentation.—Saltness of the Sea.—"Sir,—1st, I should be much obliged if you would inform me whether denudation and sedimentation can go on in the same sea or river at the same time, and what are the respective conditions necessary to each? 2nd. How do geologists account for the salt in the sea?—M. G."—The deposit of sedimentary matter takes place in comparatively tranquil water, while denudation is the effect of rough waves and strong currents. These two opposite actions are so far synchronous that they are usually going on in different and distinct parts of the same sea or river. By the natural action of a stream the detritus worn away from the higher regions is deposited at the more tranquil parts of its course, or at its mouth or estuary, or carried out to sea and deposited at various depths, according to the fineness and specific gravity of the particles. Littoral deposits of a coarser character, such as sand-banks, are frequently denuded of their upper portions during storms or by changes of currents, but in such cases, where the denudation takes place on the site of deposit, the two actions must be intermediate or intermittent and cannot be synchronous. We are not aware that any good reason has yet been assigned for the saltness of the sea. This question involves another, Whether the sea has always been salt? and in the present state of knowledge we cannot say much on the point.

Inquiry respecting Fossils.—"Dear Sir,—Could you inform me in your next number of the Geologist what is the nature of the delicate markings on the enclosed specimens? They appear to be the impressions of shells. M. A. M."—One of the specimens bears an impression of a *Leptæna* (a Brachiopodous mollusc) and another of a joint of Encrinite. The other specimen bears the two excessively thin valves of a *Posidonomya* apparently; one valve half overlapping the other, and both much crumpled. These fossils appear to be derived from some of the rocks, of Devonshire. One is of Devonian age, the other of Carboniferous.

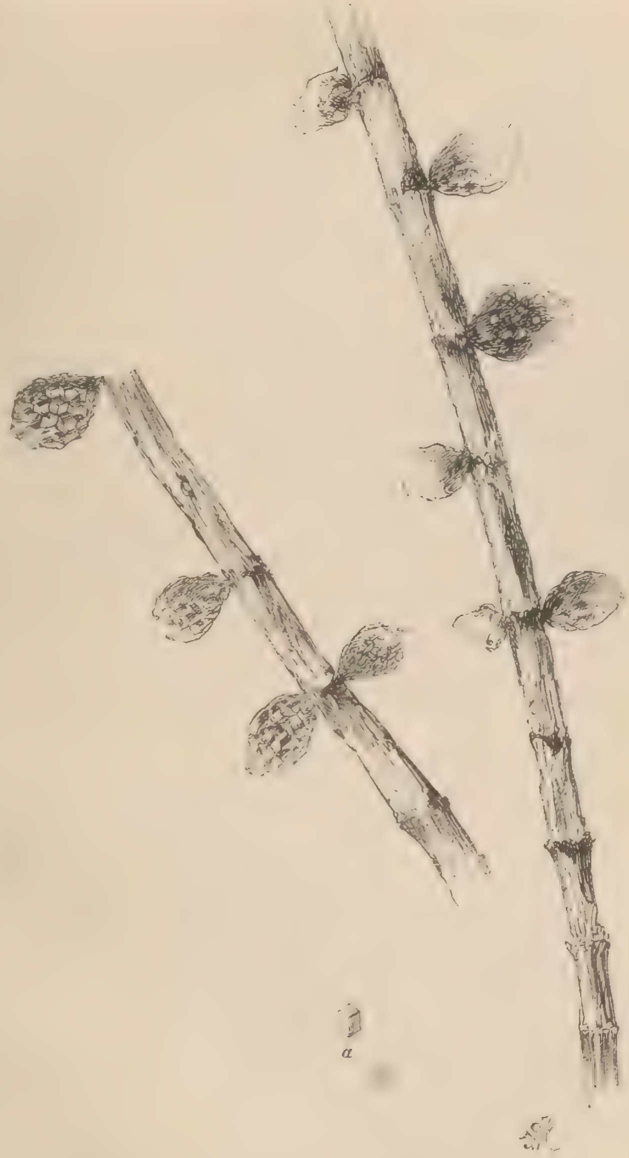
Mammalian Remains.—"Sir,—I was at Stanhope last week, and saw a rather interesting specimen which had been found in a bog to the south-west of that town. It is a horn of a cow or bull, and it appears to have lain for a very long period in the bog-earth, as it was deep down and so much decayed as to fall to pieces at what farmers call its 'year's growth.' When found it had its point upwards, but the man who discovered it had not the presence of mind to look further at the time, and, on returning since to search for further remains, has not been able to make out the exact site. The horn looks like that of a half-bred bull, but is thicker in proportion to its length than the horns of our domestic cattle. Is it anything like that of the wild bull? Yours, &c., S. Hutchinson, Waskerly Park, 13th Sept."—There are three or more kinds of fossil ox indicated by remains found in our bogs. If S. H. will send the exact measurements and an outline of the specimen, we shall be better able to reply to his inquiry.

Inquiry respecting some Fossils, &c.—E. E. Byng, Leamington.—The Ammonite, a fragment of a cast of which accompanies Miss E. E. Byng's letter (Leamington), belongs to the species known as *Ammonites Conybeari*, common in some parts of the Lias. Belemnites are often termed "Thunderbolts" by the peasantry in Somerset and elsewhere; but are easily recognized as fossilized creatures by their peculiar structure, and by their consisting of carbonate of lime; whereas meteoric stones consist of iron and other hard matters. Besides the 'Great Northern Drift," there have been several local drifts, chiefly due to river-action, in Warwickshire and the adjacent counties; and the pebbles to which E. E. B. alludes may be derived from one or the other—probably from the river-gravel of the Severn. The fragment of rock sent in the letter is quartzite, that is, altered and hardened sandstone; probably it is from the Lickey Hills. E. E B. will see that it is not limestone or cornstone, because it is too hard to be scratched with a knife, and will not effervesce with acids. We are obliged by the writer's kind acknowledgements of the usefulness of this Magazine, and for the suggestions kindly offered.

Drift near Oswestry.—"Dear Sir,—At and around Oswestry we have a deposit of local drift of considerable thickness. The gravel and boulders being for the most part fragments of the adjacent rocks of millstone-grit, mountain-limestone, Silurian shales, and of igneous rock, from the bands with which this locality is intersected. I am anxious to ascertain if, mixed up with, or overlying, or contiguous to, this local deposit, any of the 'Northern Drift' exists. And I have thought that probably you might, through the pages of the Geologist, aid me in recognizing the latter deposit. I am, dear Sir, &c., D. C. Davies, Oswestry." —Much valuable information relative to Mr. Davies's inquiry will be found in Sir R. I. Murchison's "Silurian System," p. 528, &c. We abstract the following notice from this work :—The 'Northern Drift' reaches almost to London on the eastern side of England, and covers large tracts of country along the borders of Wales. In Lancashire, Cheshire, Shropshire, Staffordshire, and Worcestershire it consists, in some parts, of thick masses of clay; in others, of sand and fine gravel; in all of which large boulders of *granite* are mixed up with some local detritus and sea-shells of existing species. Near Wrexham it forms masses of vast thickness, containing a variety of granite-pebbles, mixed up with a large proportion of the adjacent Welch rocks, including the coal-measures; and the same distribution of materials prevails to Oswestry, where the northern course of the drift seems to have been checked by promontories of the Carboniferous rocks.

Plant from Coal-measures of the Elled Patch.—"Dear Sir,—In my collection of the coal-flora from the Elled Patch (see page 126) I have the original specimen of the enclosed sketch, and of which I can find no description, and am rather at a loss to know of what kind it may be. I have therefore drawn it, in the hope that Mr. Bunbury, or some other experienced geologist or botanist, will enable me to find out its name. I may here suggest that it would be an exceedingly useful thing if anybody possessing an unique or interesting fossil, would take the trouble to draw it to the best of his power, and send it to the pages of the Geologist, to be inserted or not, according to circumstances; for I am sure that by so doing, a number of valuable, and, perhaps, unknown specimens will be brought into notice, and help to elucidate many doubtful points. The fossil which I have attempted to delineate is apparently the fruit of an equisetaceous plant, and is about one-third longer than I have here represented. It is evident that the shorter stem is not a branch of the other, because it will be noticed that they are reversed in position, the long one being upside down. The stem is jointed at tolerably regular intervals, and marked with faint, longitudinal, and irregular lines. The fruits, which are ill-preserved in the long stalk, are opposite, almost similar, and are not composed of imbricated scales, like the *Lepidostrobus variabilis*, but each scale is distinct, and fitting into those around it. At *a* is an enlarged view of a scale, which is three-sided, and stands out in the uppermost fruit very distinctly. As a rule, fossil fruits are scarce in the South Wales coal-fields, with the exception of *Lepidistrobus variabilis* and *L. ornatus*, both of which I have frequently met with. I have also specimens of *L. pinaster*, but *Carpolithes* and *Trigonocarpum* I have never found here.—Yours truly, G. P. Bevan, Beaufort." [See Plate xi.]

Derivation of Names of Fossils.—"Sir,—May I be allowed to suggest to your correspondent, Mr. Morris, that the value of his contributions on 'British Fossils' would be very much enhanced by giving the etymology of the names of each fossil, in connection with its stratigraphical position. By this means the labour of the student of palæontology would be much facilitated, and be made considerably more interesting and satisfactory. I can conceive of nothing more wearying and tedious than having to load the memory with unmeaning, arbitrary names; and such are most of the names of the fossils to the young student who has had no means of acquainting himself with the history of their discovery, or the peculiarities in their respective appearances, or resemblance to some known form of animal or plant, from which they have been named. As Mr. Morris has already gone far in his papers on 'The Stratigraphical Order of British Fossils,' he may perhaps be induced to favour the readers of your very useful Journal with separate papers on 'The Etymology and Pronunciation of the Names of British Fossils.'—Yours, &c., Mark Fryer, 3 St. James's-square, Bristol."—



PORTION OF A PLANT FROM THE COAL-MEASURES, SOUTH WALES,

FROM A SKETCH BY DR. BEVAN.

We have already expressed our intention of printing a glossary of geological and scientific terms in the columns of this Magazine. This glossary will contain the derivation and pronunciation of generic and specific names, as well as of all technical terms; its object being to assist the student by carefully-worded and correct information upon every essential point.

PRIVATE COLLECTION, ISLE OF WIGHT.—"DEAR SIR,—I value the hints of the Rev. P. B. Brodie, respecting private collections. I shall be happy to show mine to any geologist visiting the Isle of Wight—it is chiefly illustrative of this locality. I can give admission also to a public collection (which it has been my pleasure to usher into existence) illustrative of the natural history of the Isle of Wight—the chief feature of which is its geology. In my opinion, all local museums should have for their chief object the illustration of their immediate neighbourhood, whether of geology, history, or aught else; illustrations of distant places should be made strictly secondary. I will, if you approve, give you a brief description of some of the most interesting specimens of palæontology in my keeping. At page 263, I perceive that the Warwickshire Natural History Society, desire to add to their collection of Isle of Wight specimens. I shall be happy to aid them on receiving a notification that my aid for that purpose is desirable. In respect to this locality, I am ever ready to aid the distant resident in any way in my power.—Faithfully yours, ERNEST P. WILKINS, F.G.S., Newport, Isle of Wight."—We shall be pleased to receive the contribution promised by Mr. Wilkins.

SOCIETY OF AMATEUR GEOLOGISTS.—"DEAR SIR,—I read with pleasure the proposition for an Association of Amateur Geologists in a late number of your GEOLOGIST. This is a thing I have long been wishing for, indeed, at the time of reading it, I had an unfinished letter upon the very subject, which I intended sending to you, but which was rendered unnecessary by the appearance of the one now under consideration. I am in exactly the same position as Mr. Heyward, as regards isolation, time, means, &c., and should, therefore, hail as a great boon the formation of such a Society, and should be most happy to unite with him in the carrying out of his excellent project. If he will oblige by furnishing me with his address, I will communicate with him at once upon the subject.—Yours, &c., GEO. S. PENSON, 28 Clement's Lane, Lombard Street, E.C."

INQUIRY RESPECTING A FRAGMENT OF A BOULDER, by Mr. Thomas F. Evans, Mona-Lodge, Amlwch.—We are obliged by Mr. T. F. Evans's note, sketch, and specimen; but from the evidence with which he kindly supplies us, we should be disinclined to suppose that the boulder to which he refers is anything more than a portion of a curiously-fashioned irony concretion.

FOSSILIFEROUS LOCALITIES IN NORTH WALES.—"SIR,—Can you, or any of your readers inform me whether I should, in the course of a ramble through North Wales, meet with any localities where fossils are particularly plentiful. I intend visiting the following places, viz.:—Llanfair, Mallwynd, Dinas Mowddy, Cader Idris, Dolgelly, Maentwrog, Fan-y-blwch, Tremadoc, Beddgelert, Snowdon Llanberis, Caernarvon, Bangor, Penrhyn Slate Quarries, Capel Curig, Bettws-y-Coed, Bala, Corwen, Llangollen, Chirk, and Oswestry. As my time is limited. I should be glad to know the exact localities where I could easily obtain a few good specimens. Will you please also inform me the magnifying power of a microscope sufficient to show distinctly Foraminifera, Diatomaceæ, &c. Allow me to contribute my mite of thanks for the valuable information contained in the pages of the GEOLOGIST, and for the facilities afforded to students (like myself) for obtaining information through your column of 'Notes and Queries.'—Yours, &c., S. W. W."

SUPPOSITION OF COAL AT BLACKHEATH.—In our reply to the questions of "N. Z. Fossil" in our last number, we casually omitted to state that the popular belief of the existence of coal at Blackheath has, doubtless, arisen from the observation, by uninstructed persons, of the small bands of lignite occasionally present in the tertiary strata in the neighbourhood of that place.

HEMATITE-ORES.—"SIR,—Will you be good enough to inform me in your next whether any work has been published on Hematite ores; and their whereabouts, especially whether they occur at the base of the conglomerate.—Yours obediently, R. F. LASCELLES JENNER, Wenvoe."

MINERAL VEINS.—"SIR,—Will either you or any of your correspondents have the kindness to inform me, why mineral veins, in general, contain more iron in limestone than in siliceous strata?—Yours, J. C."

GEOLOGY OF HUNTINGDONSHIRE.—"DEAR SIR,—Will you please to tell me whether the geology of this county has ever been published, and if I can get a map of it, correctly coloured according to its geology. I think it would add greatly to the value of the GEOLOGIST if a short and clear account of the geology of each county appeared in it from time to time.—Yours &c., R. A. C., St. Ives, Huntingdon."

GEOLOGY OF BRIDPORT, &c.—"SIR,—Could you favour me in your next number with the names of any good spots within walking distance of Bridport, Weymouth, Christchurch, or Chichester for obtaining characteristic fossils and observing the structure of the country. Are there any "geological desiderata" in these neighbourhoods to which attention should be more particularly directed?—A STUDENT, Hampstead."

OCEANISTIC THEORY, &c.—Mr. John Curry, Boltsburn, Darlington.—We are much obliged for Mr. Curry's communication and his statement of the "Oceanistic Theory," but at present decline to publish it, as we should not be disposed to find room for the discussion which would necessarily follow.

AMATEUR GEOLOGIST'S ASSOCIATION.—The Editor of the GEOLOGIST has received letters for Mr. Heyward, but cannot forward them, not knowing that gentleman's address.

BRITISH ASSOCIATION MEETING.

THE 28th meeting of the British Association commenced at Leeds on the 22nd ult., under the presidency of Professor Owen, and has been attended by even a larger number of *savans* than are usually present at these gatherings. The president's address is far too lengthy for insertion in full, but its interest is such that we give an abstract of its principal topics. He commenced by referring to the capacity God had given to man to discover and comprehend the law by which his universe is governed, and man impelled by a healthy and natural impulse to exercise the faculties by which that knowledge can be acquired; and thus the most important inductive researches, so far from being the wilful soarings of speculative philosophy into almost forbidden mysteries, are commonly the observations of men so placed by circumstances as to have the work of investigation allotted to them as part of their daily duties. Great and marvellous have been the results of such philosophical investigations, not only in respect to the shape, motions, and solar relations of the earth, but also of its age and its inhabitants. The mind strains to grasp the sum of past time in the age of our globe, with an effort like that by which it tries to realize the space dividing its orbit from the fixed stars and nebulæ. Yet during all those eras which have passed since the Cambrian rocks were deposited, bearing the earliest recognized stamp of created life, it has been manifested through the interpreters of the "writings on stone," that the earth was vivified by the sun's light and heat, fertilized by refreshing showers, and washed by tidal waves.

At no period has the gift of life been monopolized by a few contemporary individuals through a stagnant sameness of untold time; but it has been handed over from generation to generation, and successively enjoyed by the myriads that constitute the species. Through death the individual enjoys all the varying phases of life; and not only individuals but species perish. Still, as death is balanced by generation, so extinction has been concomitant with creative power, which has continued to provide a succession of species; and so far as the varying forms of life which this planet has witnessed, there has been an advance and progress in the main.

Geology demonstrates that the creative force has not deserted this earth during any of her periods of time, and that in respect to no one class of animals has the manifestation of that force been limited to one epoch.

In the reflection that at how late, and in how brief, a period of historical time, geological knowledge has been acquired, we must feel that, vast as it seems, it may be but a very small part of the patrimony of truth destined for the possession of future generations.

Comparing the realities of the Association in its labours with the "Solomon's House" of the "New Atlantis," and the realities of our national and private observatories, our museums, our learned societies, and zoological, botanical, and horticultual gardens with its imaginary departments, it seems as if we were realising that grand philosophical dream, or prefigurative vision of "the father of modern science." We can scarcely appreciate the rate of progress of human knowledge unless we go back for an instant to that period which is thus chosen as the starting-point of this survey.

From Bacon's treatment of the Copernican theory we are passed onwards to Galileo's invention of the telescope and the discovery of the four small moons revolving round Jupiter, the analogy of which to the Solar system as conceived by Copernicus, gave the "holding-turn" to the opinions of mankind respecting the heliocentric system; and hence we are progressed through the first observations of the transits of Mercury and Venus across the sun's disk, and those other observed facts upon which the motions of the heavenly bodies have been determined and the laws which regulate them made out, to those more abstruse investigations on the laws of gravitation and those other difficult problems which are now being worked out.

The progress of knowledge of another form of all pervading force, which we call from its most notable effect on one of the senses, light, has not been less remarkable than that of gravitation.

Galileo's discovery of the satellites of Jupiter supplied Romer with the data for measuring the velocity of light. Descartes, in his theory of the Rainbow, referred the different colours to the different amount of refraction, and made a near approximation to Newton's discovery of the colours entering into the composition of the luminous ray, and of their different refrangibility. Hook, and Hughens, and Newton, entered into explanations of the phenomena of light, and the names of Young, Malus, Fresnell, Arago, Brewster, Stokes, Jarmin, and others, have been successively associated with the discoveries of achromatism, of the laws of double refraction, of polarization, circular and elliptical, of dipolarization, and those later advances of optics which have realized more than Bacon conceived might flow from the labours of his "perspective house." Some of the national sciences, as we now comprehend them, had not germinated in Bacon's time. Chemistry was then alchemy; Geology and Paleontology were undreamt of; but magnetism and electricity had begun to be observed and their phenomena compared and defined, and entitled to be regarded as the first step toward a scientific knowledge of those powers.

It is true that long before the 17th century the magnet was known, and the compass had guided the mariner's bark through trackless seas, but to Gilbert is due the observation of the phenomena that electricity attracted light bodies, while magnetic force acted upon iron only.

A century later the phenomenon of repulsion was detected. The conduction of electric force and the different behaviour of bodies in contact leading to their division into conductor and non-conductor next followed. The definition of two kinds of electricity, negative and positive, formed an important step, which led to a brilliant series of experiments and discoveries, with inventions, such as the Leyden jar for intensifying the electric shock. The instantaneous transmission of electric force, the application of the lightning conductor, the association, as belonging to one principle, of electricity, magnetism, and galvanism have emanated in unbroken succession from the concatenation of circumstances and the persevering and ingenious experimental researches by which the elucidation of these recondite phenomena have been effected

The present tendency of chemistry is towards a reduction of the number of those bodies hitherto considered as elementary ; rapid, indeed, has been the growth of organic chemistry through the labours of Hoffmann, Berthelot, and others. The important power of synthesis has grown with this growth. Since Wöhler, in 1828, succeeded in artificially producing "urea," Kolbe has similarly, by the combination of inorganic elements, produced acetic acid ; while Berthelot has formed glycerine ; of the bases of vegetable oils and fats he has also formed grape-sugar, and has realised the synthetic preparation of camphor. An important series of alcohols and derivatives, as extensive a series of ethers, including those which give their flavour to our choicest fruits, together with other important organic bodies, are now capable of artificial formation from their elements, and the old barrier dividing organic from inorganic bodies is broken down.

Since Niepce, Herschell, Fox Talbot, and Daguerre laid the foundations of photography, year by year some improvement is made—some advance achieved in this most subtle application of combined discoveries in photicity, electricity, chemistry, and magnetism.

(*To be continued.*)

REVIEWS.

The Mining and Statistic Magazine. By Thomas McElrath. No. LXII. August, 1858. New York : George M. Newton.

This number of a very useful and instructive magazine has reached us from the other side of the Atlantic, and has afforded us much pleasure in the perusal. Its articles are generally of a practical character, many, of course, being of local value ; but there are others which will be read everywhere with interest. Such is the first part of a very interesting essay, by S. P. Leeds, upon the influence which water holds in mineral veins.

This inquiry is a very important one, if it be true, as it generally stated, that dry veins are barren, and that with the abundance of springs of water hey become more and more prolific. The elucidation of the present question would go far, in connexion with other inquiries, to determine the principles which govern the formation of metallic veins, and, as the author of this essay justly observes, such knowledge would be of inestimable value to the miner, as it would teach him to discover upon an early examination of a vein, whether it would be a productive or a barren one.

Certain laws or principles must govern the formation of all mineral veins, which cannot be the result of fortuitous circumstances ; the circumstances attendant upon them are too uniform in character to be the effect of casualties ; and the forces which have caused the deposition to their metallic contents are still in active operation. Nature, except in isolated instances, ever produces the greatest results from minute materials and long-continued action.

If the metallic deposition in those veins which have been allowed to refill with water is plainly perceptible in the brief period of one or two centuries, it is evident that much of the character and quality of a vein depends upon the water circulating through it ; which not only merely acts as a solvent, but brings into activity electric, chemical, and other subtile forces essential for the concentration or deposition of metallic particles.

"Those portions of a vein," says Mr. Leeds, "which from the peculiar conformation of the country around them are drained of their water, are usually the most unproductive. They appear, like the dead bark upon a tree, to contain no life, and to possess no mineralizing properties. The ores are usually in a state of decomposition, or seeming decay, and the whole metallic appearance is that of a state of decrease. This peculiar condition of the veins above what is technically termed the "water-level," is unfavourable to all except gold-veins. In them the decomposition of the ferruginous pyrites has had the tendency to liberate the minute particles of gold, and render them more accessible to the manipulating machinery; but, with this one exception, the veins are not considered valuable above water-level. And it is the very absence of 'vitality,' in the exception just named, that causes this temporary benefit; for even in gold-veins the ores are more rich at and below water-level, for permanent and enduring work, than they are above it; but the ores from below the water-level, from their hardness, require more labour to extract the gold. Below the water-level the pyrites remain unchanged, the wall-rock maintains its primitive induration, and the gangue-stone holds its natural structure. Above the water-level the pyrites will be found altered from its bright, glistening hue and compact structure, through all the changes, from a slight oxidation merely coating its exterior, to an entire decomposition into a soft pulverulent form."

After quoting from various anthors to confirm the truth of this proposition Mr. Leeds divides his investigation of the action of water in veins into these heads:—1st, Its Properties as a Solvent; 2nd, Its Mechanical action; 3rd, Its Electro-magnetic bearing; and 4th, Its Chemical power.

Although it may be difficult to determine the extent to which water is capable of acting upon metallic salts or substances, yet the purest metals, when sufficiently divided, are soluble in water. It has been shown that silver, mercury, lead, copper, and other metals have been taken up by water and deposited on the surface of rifts, as in the Christiana Mines in Norway, in Peru, and in other mining districts. "When, therefore, water impregnated with sulphur meets the same element charged with metals, permeating the joints and pores of the rocks, precipitation takes place, and a compound is formed in accordance with the laws of affinity. Again, although the process of the formation of metallic matter may be extremely slow, circumstances are recorded which appear to prove it may be, in some instances, perceptible. Mr. Trebra, director of mines in Hanover, has stated that "he had seen a leather thong suspended from the roof of a mine, coated with silver-ore; he had also observed native silver and vitreous silver-ore coating the wooden supports left in a mine called Dreyweiber, in the district of Marienburgh, which had been under water 200 years.'' "At Wolfclough Mine, in the county of Durham, which was closed for more than twenty years, and opened again, needles of white lead-ore were observed projecting from the walls, more than two inches in length."

So when veins which have long been kept dry by artificial means, have been allowed to refill with water, and remain so for many years, it has been found, on opening them, that the mineral deposition has again progressed during their interval of repletion. The deposition of copper and silver upon the timbers, or upon leaves floating in old mines, is of frequent occurrence; and the abundance of mineral springs in all parts of the globe is evidence, also, of the solvent powers of water. In many of them we find solutions of the salts of iron, copper, silver, &c. of sufficient strength for these to be deposited by simple evaporation.

This solvent power is manifested more especially when the water is impregnated with certain gases, or with alkaline solutions, the oxides of metals being most freely acted upon by the latter; and, as all the primitive and many other rocks contain potash, it is easy to perceive that there is abundant provision in nature for the solution and transportation of metals through the medium of aqueous currents, in the veins.

The original spaces of decomposed crystals of the feldspar, forming an ingredient of the natural rock, are not unfrequently refilled with peroxide of tin; even part of the original feldspar sometimes remaining, according to the extent to which the disintegration has proceeded; and sulphate of baryta, a substance usually termed insoluble, and common in lead-mines, occurs under circumstances which leave no doubt of its having been deposited from aqueous solutions. It has been known to replace portions of corals in the mountain-limestone of Derbyshire.

Regarding the difference of the substances held in solution by hot mineral springs, and those found in metalliferous veins, M. Elie de Beaumont has pointed out the reason why, notwithstanding the intimate relations of such springs with the formation of mineral veins, the contents should not be expected to be identical: the fact being that those substances which are least soluble are not discharged by the hot springs, because in the flow upwards of the thermal water, each change of temperature in cooling, as they mount towards the surface, causes a precipitation of the least soluble substances on the walls of the fissure, while the alkaline salts and other readily soluble substances are retained in the water, and discharged by the springs.

The second point considered is the mechanical action of water. This influence in the degradation of rocks and transportation of particles of matter is so commonly apparent that we need not dwell on it in this review. Two points noticed are, however, worthy of insertion. Referring to various conditions under which silica is deposited, Mr. Leeds continues, that the "vein-fissures may owe their origin to the gradual deposition of the gangue-stone forcing asunder the wall-rock. The expansion of a small quantity of water in a crevice while passing by freezing to a solid state will dissever large masses of rock. The gradual deposition of the silica into the crevice may, by passing from a fluid to a solid state, widen the fissure and enlarge the vein. Such a course of production would account for the presence of those fragments of wall-rocks which are found in the body of the vein; they have been left in their position, enclosed in the gangue-stone, by the gradual receding of the wall-rock. Had the vein been an open fissure from the first, those fragments must have fallen to the lowest depths; nor would the wall-rocks have been able to sustain their position—the 'hanging-wall' or roof of the vein must have fallen to the 'foot-wall' or floor. When even a brief extent of the solid contents of the vein is removed, it becomes one of the most difficult practical problems in mining engineering to sustain the walls in their original position. How utterly impossible it would have been for them to sustain that position, if without support throughout their whole extent."

He then quotes from our countryman, Sir Charles Lyell, in reference to calcareous springs, that "the constant transfer of carbonate of lime from the lower or older portion of the earth's crust to the surface must cause at all periods, and throughout an infinite succession of geological epochs, a preponderance of calcareous matter in the newer as contrasted with the older formations."

In the consideration of the mechanical or transporting action of water, we have, besides the operations effected by its upward flow, to consider those effected by its percolation downwards.

When the waters sink into the ground they carry downwards such soluble salts as they meet with on the surface or beneath the soil, and deposit them either in this course or on meeting with other water holding different salt in solution.

"And here the question may be asked, What becomes of all the metals that are raised by man to the surface of the earth? England alone produces nearly three millions of tons of iron annually; while the aggregate of all the metals produced throughout the world would startle the mind, and task the eye by its long array of figures. Year after year this active production has been in operation, from the days of Tubal Cain to the present time; greatly increased, it is true, in the past few centuries; and if but a tithe of the whole amount ever produced was now in existence, the whole surface of the globe would, or could, be encased with a dense covering of solid metal. In the beautiful economy of nature nothing is lost, nothing annihilated; and in the comminution by actual use, for every contact with a metal causes a wear upon its surface,—in the chemical action of the atmosphere, with its mechanical alternating effect by changes of temperature,—and in the solvent and mechanical properties of the water, re-conveying the metallic particles and salts to the interior of the earth, may, perhaps, be found the only satisfactory solution of the inquiry."

The third division of the inquiry is in its *electro-magnetic* bearing, and opens a wide and little-explored field of inquiry, but which promises to "throw open to the researches of the student truths of the highest and most fascinating character," and presenting "scope for the boldest strides of genius."

"Why is it, that during its position in the vein, and attached to or forming a portion of the vein-rock, that fragment, which when broken off, so speedily undergoes a change in its chemical, and consequently in its physical construction, should remain unaltered? If any change could be perceptible in it, while in its original position, it would be that of an increased metallic value. There would, if it were examined in a vital portion of the vein, be found a gradual accumulation of metallic particles. Let us take a fragment of pyritous ore—auriferous pyrites, and, before being abraded from the vein-rock, the pyrites is of a bright glistening surface, hard, firm, and glass-like in its brittleness, with no visible appearance of the gold, and to the inexperienced eye it would present no feature of intrinsic worth. It is broken from the vein-rock, and without being removed from the adit-level in which it was obtained, it is allowed to remain under the surface of the flow of waste vein-water which passes along the 'floor' of the level. But a few days shall have elapsed since its separation from the rock, and yet an oxidation of the iron of the sulphuret will be found to have commenced. The bright surface of the pyrites appears covered with a ferruginous rust, but still no gold is visible. The oxidation, as time passes, will be found to increase, and the brightened colour of the specimen will show that its iron has passed from the condition of a sulphuret to that of a peroxide. In its physical character it will be found to have passed through a wide mutation. It is no longer compact and indurated, but is a slightly cohesive mass, which, under the lightest friction, falls into a soft, partially-gritty powder, intermixed with which are plainly discernible the glistening particles of the yellow gold. This is not a surmised case; it is a true picture of a phenomenon that is continually witnessed by the workers in gold-veins. Why, I repeat, is the pyrites kept from decomposition, while forming a portion of the actual vein, and why does its decomposition so speedily commence when removed from its primal condition? Is not the cause evidently to be found in the fact, that the vital forces of the vein are still in operation, and that they possess the power of resisting decay? Above the water-level we find this decomposing action pervading the entire scope of the vein; below that point the oxidation has not progressed. The water evidently claims a preservative influence over the constituents of the vein. So long as the water procolates freely through the interstices of the vein, so long will a medium exist through which and by which the electro-magnetic forces will act, and the decomposition of the vein be held in abeyance. While those forces continue in full activity, aided by the solvent and mechanical action of the water, the deposition will progress, and the vein continue to accumulate its mineral wealth. As the vital principle of the plant or animal does not create any new material in the growth of its subject, but augments its quantity by the process of assimilation, so the vital forces of the vein do not create the metal, but act by transposition of metallic substances from the depths of the earth and the surrounding wall-rocks, to the body of the vein. For the verity of this assertion we appeal to the practical facts of the laboratory. Crosse has produced various metallic salts by electric action. The deposition of metal by the electrotype process is too familiar to all to require description; and the labours of Fox and others, in the direct application of electro-magnetic force upon mineral veins, should satisfy even the most sceptical, by the clear, broad light of truth which surrounds them."

The consideration of the fourth point is reserved by Mr. Leeds for a future number.

The other articles on gold-mines and the distribution of that precious metal in this number of the "New York Mining Magazine," will be perused also with interest, especially in regard to the question of the extension downwards into the solid rock of the gold-bearing veins; practical facts seeming to prove that, at any rate in some instances, the vein continues actually as rich, or richer even, in gold in its downward progress; but that the rock not having undergone the decomposition usually attendant on its upper portion, the metal is not so visible or so easy of extraction.

In the report of the Pascoe Gold-mines in Georgia by C. H. Shepard, for example, we are told that the quartz-veins exhibit the usual phenomena of lodes, and that, although gold occurs in places inclosed directly in the quartz, "it is nevertheless true that its chief repository is in the pyrites," which occurs "not only in the joints of the quartz-rock but is diffused through its entire substance. Sometimes its proportion rises to one-quarter part of the veins; and rarely it constitutes large wedges and ovoidal masses in a state of almost absolute purity." The reader may find some interesting and confirmatory remarks on the subject of the derivation of gold from the pyrites, by Mr. Odernheimer, in the Geological Society's Journal, vol. xi. p. 401.

"There is no foundation whatever," Dr. Shepard adds, "for the opinion that the quartz-veins grow poorer in gold with their depth, at least in the usual repositories where it is associated with pyrites. The contrary would rather seem to be the fact, although it is undoubtedly true, that, as the shafts and galleries penetrate deeper, and enter the region beyond the decomposing influence of the atmosphere, the gold becomes more and more inaccessible to the old method employed for obtaining it.". We do not pretend to enter into the discussion on this point, which is one, however, so important in its geological bearings, that the statements on both sides deserve careful consideration.

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PALÆONTOLOGICAL NOTES ON THE BRACHIOPODA.

By Thomas Davidson, Esq., F.R.S., Sec. G.S., &c.

(*Continued from page* 416.)

In our second group are provisionally assembled a number of Terebratula-shaped species, with a curved hinge-line, no defined area, beak entire, or truncated by a circular foramen for the permanent or temporary passage of a peduncle, and with spiral appendages directed outwards, as in Spirifera, but connected by a more complicated system of lamellæ. Much has, however, to be discovered concerning the interior details of the larger number of the species before we can hope to establish permanent and satisfactory divisions in this group.

The genus *Athyris* has for years attracted the notice of palæontologists, but it was not until a recent period that all its important characters could be established. The species vary considerably in their external shape; they are circular or angular, elongated or transverse, smooth, ribbed, or striated, some have the entire surface of their valves covered with numerous concentric plates, which are prolonged in many instances nearly an inch from the surface of the shell, while in other species the valves are covered by a vast number of scaly ridges from which radiate closely-set fringes of elongated, somewhat flattened spines; and so close are these sometimes in their arrangement, that no portion of the shell can be distinguished.

The beak of the larger valve is likewise at times so much incurved over that of the smaller valve that for many years it was erroneously imagined there existed no foraminal opening in the species of this genus; and it was this which led Professor M'Coy to designate the group by the name of *Athyris*, the etymology of which would imply a shell without a door, or, in more appropriate words, without an opening.* It is, however, certain that the larger number of species and specimens exhibit a clearly truncated beak and circular opening, so that all that can be inferred is, that the animal could, at some time of its existence, or from peculiar causes, dispense with its mooring, and that this was caused by the beak becoming so much incurved or adpressed as to leave hardly any space for the passage of peduncular fibres.

In the interior of the large valve the hinge-teeth are supported by vertical shelly plates, and the free space on the bottom of the valve between and beyond these is filled up with muscular impressions. The muscle whose function was the closing of the shell has formed a small, elongated, mesial, heart-shaped scar, and under, as well as along the outer side are seen the impressions of the cardinal or divaricator muscles —that is to say, of those which had the office of opening the shell. The impressions of the pedicle or ventral adjustor muscle may also be clearly or distinctly seen on either side close to the abductor; so that the muscular impressions appear to have been very similarly placed in this valve of *Athyris* as in the corresponding one of Terebratula, although no trace of the accessory divaricator and capsular, or peduncular, muscle could be perceived; but it is right to observe that these are not always distinctly seen even in the Terebratulæ.

In the interior of the smaller valve the hinge-plate presents four depressions or pits, which afforded attachment to the dorsal pedicle or dorsal adjustor muscles, and which served, according to Mr. Hancock, to move the shell on the peduncle, and to adjust it.

This hinge-plate is likewise perforated close to its summit (under the umbone) by a minute circular aperture, which in some species has been seen to communicate with a small cylindrical tube, which, after originating under the platform, extends longitudinally and freely, with a slight upward curve, to about a third of the length of the valve. On the bottom of the shell, divided by a small longitudinal ridge, may be clearly seen the impressions left by the adductor longus anticus of Owen (anterior occlusor of Hancock); but those of the posterior occlusor could not be distinctly seen on any of the valves that have come under my examination. It is probable that the occlusor muscle had four attachments in this valve, as in Terebratula and other genera. On each side of the hinge-plate above described, and of its aperture, exists a prolonged testaceous plate, situated at a higher level, and forming the ledge or rim of the inner socket-walls. These two prolongations become lengthened, and give origin (while serving as points of attachment) to the two lamellæ (*a*), which, by their convolutions on either side, constitute the spires, as well as the intermediate process by which they are united. The spiral lamellæ, disposed vertically to the plane of the valve, converge at first, then bend suddenly upon themselves, at a short distance from their origin, outwards and backwards (*b*) in the shape of a half-circle, which, passing first close to the sockets (*b*), then follow in the direction of the bottom of the valve (*o*, *c*) to become recurved again, and thus producing the first of the seven or eight convolutions of which each cone is composed. From the first two spiral lamellæ spring up perpendicularly other two secondary ones (*o*, *d*), which, by being bent, become united towards the middle of the shell (*d*) between the two spiral cones, and afterwards form but a single branch (from *d* to *c*). This last, after having attained the upper level of the spire (at *e*) becomes again bifurcated, and forms other two lamellæ (*f*) recurved in half-circle, and terminating backwards by a free extremity (*g*) between the first and second coil of each spiral cone.

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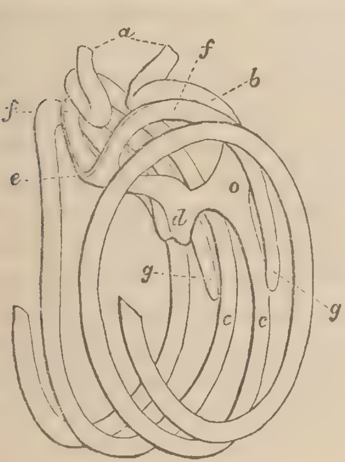
* The term *Cleiothyris* had been proposed some years before by Professor Phillips for the same kind of shells, but its etymology is liable to the same objection as that of *Athyris*. On the Continent, the generality of authors refuse to adopt either of these denominations, and prefer that of *Spirigera*, more recently proposed by D'Orbigny, and I would willingly adopt this last denomination were it not that, both in this particular and many others, naturalists still retain names which imply zoological contradictions.



Such, at least, are the dispositions of the spiral and other parts in *Athyris pectinifera*, and are probably the general dispositions of the group; but it would be very important to discover whether the spiral processes are similarly disposed in the *Athyris concentrica*, *A. Roissyi*, and in some other species of the same genus, especially as in the last two the interior characters of the shell have been ascertained to be similar.

The term *Merista* has been proposed by Professor Suess to distinguish certain similarly-shaped species, but which exhibit some peculiar interior dispositions not to be found in *Athyris*. It is, however, certain that in the young condition *Merista* was possessed of a circular aperture for the passage of a peduncle, which became obliterated at a more advanced age from the incurvation of the beak. The interior of the larger valve differs from that of *Athyris* in the presence of an arch-shaped plate or process, which is situated between the dental plates, and in the smaller valve by the absence of a regular hinge-plate, this portion of the shell being divided by a narrow channel, from which a large, deep, longitudinal septum originates, extending to about two-thirds of the length of the shell, while in *Athyris* a small ridge is alone observable. The spiral processes are fixed to the prolongations of the socket-ridges, and have their extremities directed outwards, but the exact shape of the connecting process has not hitherto been clearly shown. It will therefore be very desirable that researches should be continued until a complete restoration of all the interior parts can be represented. The shell-structure of both *Athyris* and *Merista* has been found to be impunctate.*

The term *Retzia* has been made use of by Professor King for the reception of certain Terebratula-shaped shells, which possess a small hinge-area, truncated beak, and circular foramen, which is partly completed by a distinct deltidium. The spiral appendages have their extremities directed outwards, and the intimate shell-structure is punctate; but further research will be required before the exact interior dispositions and details can be correctly represented.

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* The muscular impressions in the interior of the larger valve of *Merista* are similar to those of *Athyris*, but we are not perfectly acquainted with those of the other valve. The presence of a hinge-plate is not absolutely required for the insertion of the dorsal pedicle or dorsal adjustor muscles, for Mr. Hancock has observed that "in *Waldheimia cranium*, and in *Terebratulina caput-serpentis*, the dorsal adjustor muscles are not attached to a hinge-plate, but are inserted into the valve itself, and that in a species differing but little from *W. Australis*, the divaricators and accessory divaricators are united."

At pages 207-218 of the third volume of the Palæontology of New York, Professor J. Hall has proposed two new genera, or sub-genera, under the names of *Trematospira* and *Nucleospira;* but as I am not acquainted with any of the species of which they are composed, and as the Professor's plates referring to those forms are not yet in my possession, all I can do at present will be to furnish extracts from the author's own descriptions.

Trematospira is stated to be a Terebratula-shaped shell, with internal spires arranged as in *Spirifera,* and that the beak of the larger valve is truncated by a circular perforation, which is separated from the hinge-line by a deltidium : so far it would agree with Retzia, but from this it is stated to be distinguished by external and other characters. The author places great stress on the presence of a deep triangular pit beneath the beak of the larger valve, which is filled up by the closely incurved beak of the opposite one ; but, as Professor Hall observes that the condition of the specimens was such as to prevent any satisfactory investigations of the interior, the genus cannot be considered as satisfactorily established.

Nucleospira is stated to be spheroidal, or transversely elliptical, with internal spires as in *Spirifera,* and that the larger valve has its beak extended beyond the opposite one, and beneath it a triangular depression or area is sometimes terminated in a shallow, spoon-shaped pit; a narrow ridge or septum extends along the centre of the inner side of the valve from beak to base; the dorsal or smaller valve is furnished with a strong spatulate cardinal process, which, rising vertically from the cardinal margin, is closely grasped at its base by the cardinal teeth of the other valve, and thence, bending abruptly upwards and expanding, is projected into the cavity of the opposite valve; this process is grooved or depressed in the centre of the upper side, so as to leave between it and the ventral beak a narrow space for the passage of a pedicle, for the protrusion of which a minute foramen is sometimes observed in the beak. From the sides of this process, above the junction of the teeth of the opposite valve and at the point where it bends upwards, originate the brachial processes which support the spires; a deep cavity beneath the cardinal process extends to the dorsal beak, from which arises a thin elevated septum, running to the base of the shell. The muscular imprints are confined to a narrow oval space. Shell-structure punctate, and, when perfect, covered with minute hair-like spines. But I must refer the reader to Professor Hall's admirable work, where several species have been carefully described.

Of the genus or sub-genus (?) *Uncites* but one or two species have been discovered, and its interior character has not been made out to my entire satisfaction. The shell is oval, elongated; the beak of the ventral valve long, tapering, and incurved at its extremity, hollow and truncated in young specimens, by a small oval foramen; no true area; a large concave deltidium partly surrounds the aperture, and extends to near the cardinal edge; the sides of the beak of the larger, as well as of the smaller, valve become sometimes considerably deflected inwards, producing deep lateral elongated depressions or pouches, opening externally, but not communicating with the interior. The muscular impressions have not been described, and the existence of spiral processes has been recorded upon the evidence of but a single imperfect specimen.

The third group is at present limited to a single genus, to which Dalman applied the name *Atrypa*, from having supposed that his shell was deprived of a foramen; but, although the aperture is in some specimens concealed by the incurvation of the beak, a small round opening, separated from the hinge-line by means of a deltidium, may often be observed not only in young shells, but in many that have attained their fullest development. The term *Atrypa* is, therefore, a misnomer, as well as that of *Athyris*, and, if retained, should be looked upon as a simple denomination, casting aside the derivation. On the Continent the term *Spirigerina* is used, but many prefer to retain the more ancient denomination. The species which compose this genus have been well studied, so that the dispositions of the interior have been almost completely discovered. The shell is circular, elongated, or transverse, smooth or variously ribbed, and imbricated by numerous squamose lines of growth, which are at times considerably produced beyond the margin in the shape of tubular spires or foliaceous expansions. In the interior of the larger valve, at the base of the teeth, a semicircular ridge curves on each side, forming a saucer-shaped depression, open in front. This space is entirely filled up with muscular impressions; the adductor or occlusor forms a small longitudinally oval mesial impression, and on either side two larger scars were produced by the cardinal or divaricator muscles, which are also flanked by the ventral pedicles or adjustor muscle in a very similar manner to what we find in *Terebratula*, *Rhynchonella*, and other of the articulated genera. In the interior of the dorsal valve there exists no distinct hinge-plate, but socket-ridges are wide, and to these are fixed two small cylindrical stems, which soon become converted into two broad spiral lamellæ, which form large vertical hollow cones, closely adpressed, with their extremities directed inwards towards the centre of the valve; in the interior of the valve quadrupled impressions of the adductor, or anterior and posterior occlusor muscle, are separated by a medio-longitudinal ridge; but all these and other internal characters will be more clearly understood by a glance at the illustrations we have given, than by the most elaborate description.

The genus *Koninckina* was established by Mr. Suess for the reception of a remarkable shell which had for long been considered as a species of Productus. The shell is concavo-convex, and considerably adpressed, the beak of the ventral valve rather large and incurved; no articulation has been hitherto discovered. The smaller or dorsal valve is concave exteriorly, convex interiorly, and the oral arms were supported by two slender spiral lamellæ, forming four widely-separated convolutions directed inwards, and almost horizontal with the bottom of the valve. No muscular scars have been detected, but the vascular impressions are strongly marked in the interior of the smaller valve.

The genus *Anoplotheca* was proposed by Dr. Sandberger for a shell which the author considered to be closely related to *Koninckina*, but differing in several particulars; it is concavo-convex, with neither area nor deltidium. The attachment of the spiral appendages is but imperfectly known; they are formed of about ten whorls, the base of the spiral coil being inclined at an acute angle on the median level of the shell, but is not parallel to it, as in *Spirifera*, nor perpendicular as in *Atrypa*. It differs from that of *Koninckina* by the greater number of convolutions. In the interior of the smaller or dorsal valve there exists no hinge-plate, but the sockets for the reception of the teeth of the opposite valve are unusually large and deep, and between these there exists a prominent peculiarly-shaped cardinal process, and under it may be seen a small oval depression, bordered by an elevated rim; but the use of this depression has not been hitherto explained; besides these, the quadruple impressions left by the adductor or posterior and anterior occlusors are divided by a mesial ridge, which fills up a large portion of the bottom of the shell. In the interior of the large valve the muscular impressions do not appear to have been satisfactorily explained; there are four principal scars visible on the bottom of the shell, which Dr. Sandberger has attributed to the adductor, but which, if we are to interpret them in accordance to what we find in other genera, we would require to refer the two smaller ones on each side of the mesial ridge to the adductor or occlusor muscle, and the larger one on either side of these to the cardinal muscle or divaricators of Hancock, which last would have their other extremity fixed to the cardinal process of the opposite valve; and thus we would have clearly defined, in their proper position, the adductor which officiates in the closing of the valve, and its antagonist, the cardinal or divaricators, the function of which was to serve in the opening of the valves. No trace of pedicle or adjustor muscles has been detected in the interior of either valve. Some further researches will also be required in order to determine the exact point of attachment of the spiral appendages.

The genus *Davidsonia* was established by Mr. Bouchard, for the reception of certain Leptæna-like shells, but which adhered to marine bodies by a larger or smaller portion of the surface of their ventral valve. The shells are transversely oval, with thick unequal valves, a straight hinge-line area and fissure, which last is entirely covered by a convex pseudo-deltidium. In the interior of the ventral or attached valve, between and below the dental projections, are situated the muscular scars left by the adductor or occlusor muscle, and on either side of these are visible the larger impressions produced by the cardinal or divaricator muscles. In the smaller valve between the largely-developed socket-walls and close to the hinge-line, a small cardinal process is observable, which served for the attachment of the cardinal or divaricator muscles, and under this, on the bottom of the valve, is seen the quadruple impression of the adductor or anterior and posterior occlusors, so that we have the two sets of muscles for the opening and closing of the valves complete.

No trace of adjustor muscles could be ascertained, and these may or may not have existed in those unperforated species which were provided with a straight hinge-line, but I have observed imprints of adjustor muscles in those Strophomena-shaped species which were provided with a foraminal aperture for the passage of a peduncle, as in *Strophomena analoga*, &c. The most important character of *Davidsonia* resides in the greater portion of the interior of the ventral valve being occupied by two conical elevations projecting more or less beyond the level of the valve, the lateral and frontal portions of these exhibiting five or six semi-circular or spiral projecting ridges, which diminish in surface and width as they approach the summit of the cone. In the interior of the smaller valve Prof. de Koninck found two conical hollows which correspond with the cones of the attached valve, and were separated by a rounded mesial ridge. Various interpretations have been advanced as to the use of these cones, but the most probable was that they were produced by the mantel, which, pressing on the spiral arms, retained some impressions of their coils, which were transmitted to the shell it was secreting. This view was expressed in the English, French, and German editions of my General Introduction; but I then supposed that the spiral oral arms were free and unsupported, as in *Productus*, *Strophomena*, &c.; but since that period Prof. de Koninck has discovered two spiral lamellæ, which were fixed to the socket-margins of the smaller valve, and formed a few vertical convolutions towards the bottom of the valve, having a somewhat similar appearance to what we perceive in *Atrypa*, only the two spirals in *Davidsonia* were not so closely adpressed as in Dalman's genus.

Such is the state of our present information regarding the spiral arms and their calcareous support, and although much has been ascertained, much more remains still to be discovered or sought for before we shall be able to furnish complete restorations of the interior of several of the proposed sub-genera and species; but I feel confident that much of the still deficient information will ere long be acquired, as several zealous and able palæontologists are using all their efforts to complete the history of a class which has afforded so much interest in every respect.

We now conclude this communication by furnishing a catalogue of all the British Carboniferous species at present known to have been provided with spiral appendages for the support of the oral arms. This investigation has occupied much of my time during the last two years, and I found that out of about 125 so-termed species, said to have been found in the Carboniferous strata of Great Britain, not more than forty or forty-one could be retained, all the remaining number being made up of synonyms of species not positively known to occur in Great Britain, or of Carboniferous shells erroneously referred to Devonian species, as well as of species belonging to other genera.* And even out of the forty here retained, a few will require some further investigation in order to ascertain whether or not they may be varieties of those already described. It is, therefore, probable that the number above given may still be somewhat diminished by reducing a few of the so-named species to the rank of varieties. Some naturalists and geologists have cast a not always unmerited reproach upon the species-makers, and I would be the last person to deny the great injury that has accrued to science by this useless burdening of the nomenclature; but I may be permitted also to observe, that the difficulty in discriminating the characters, values, and limits of species is far greater than is, perhaps, conceived by persons who have not studied the subject, or by others who, from local and fortunate circumstances, may have been able to discover certain passages of form connecting one or more of the so-termed separate species. I applaud their efforts, and am always delighted to be put right when I may have erred; for my only object is the advancement of the science to which I have already devoted upwards of twenty-five years of my existence.

The species of British Carboniferous *Spirifera, Spiriferina, Cyrtina, Athyris, and Retzia*, at present known, may, perhaps, be provisionally arranged in the following order:—

1. SPIRIFERA STRIATA, Martin, sp., Pet. Derb. tab xxiii. 1809: Dav. Brit. Foss. Brach., part V. pl. ii. figs. 12–21; pl. iii, fig. 2–6=*T. spirifera*, Lamarck. = *attenuata*, J. de C. Sow. = *princeps* and *clatharata*, M'Coy. This species must be looked upon as the type of the genus.
2. ,, MOSQUENSIS, Fischer de Waldheim, Prog. sur les Choristite. p. 8, N. 1, 1825, Dav. pl. iv., fig. 13, 14, and pl. xiii, fig. 16 = *Sowerbyi* and *Kleinii*, Fischer = *incisa* Goldfuss = *Choristites* v. Buch. = *priscus* Eichwald. This form is much rarer than the preceding one, and occurs principally in Ireland.
3. ,, HUMEROSA, Phillips. Geol. of York, vol. II, pl. xi, fig. 8, 1836: and Dav. pl. iv, figs. 15, 16.
4. ,, DUPLICICOSTATA, Phillips, Geol. of York, pl. x, fig. 1, 1836: and Dav., pl. iii, fig. 7 — 10: pl. iv, fig. 3, 5 — 11=*fasciger*, Keyserling = *fasciculata*, M'Coy.

N.B.—All these forms are closely related.

?5. ,, CRASSA, de Koninck. An. Foss. de la Belgique, pl. xv., bis fig. 5, 1843: and Dav. pl. vi., figs. 20 — 22: pl. vii., fig. 1 — 3 = *planicosta*, M'Coy. By some this shell is placed among the synonyms of *Sp. duplicostata*, by others among those of *Sp. bisulcata*, and it certainly sometimes possesses much resemblance to the one and to the other, but I have deemed it preferable, for several reasons, to retain it, at least provisionally, as a separate species. It will be desirable to assemble a greater number of specimens than I have been able to command, in order to determine the true character of this species.

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* A list of these will be found in my Monograph of British Carboniferous Brachiopoda, published by the Palæontographical Society.

6. „ PLANATA, Phillips, Geol. of York, pl. x., fig. 3, 1836: and Dav., pl. vii., fig. 25 -- 36. This appears to be a good species, and easily distinguishable.

?7. „ FUSIFORMIS, Phillips, pl ix., fig. 10, 11: Dav., pl. xiii., fig. 15. Of this only a single imperfect specimen appears to have been discovered (now in the British Museum), so that the character and value of the species cannot be considered as finally established; search for more examples is very desirable.

8. „ TRIANGULARIS, Martin, sp., Pet. Derb., pl. xxxvi,, fig. 2, 1809: and Dav., pl. v., fig. 16 — 24 = *ornithorhyncha*, M'Coy.

9. „ TRIGONALIS, Martin, sp., Pet. Derb., tab. xxxvi., fig. 1, 1809: and Dav., pl. v., fig. 25 — 34.

10. „ BISULCATA, Sow., M.C., tab. ccccxciv., fig. 1, 2, 1825: and Dav., pl. v., fig. 1: pl. vi., fig. 1 — 19: and pl., vii., fig. 4 = *semicircularis*, Phillips = *calcarata*, M'Coy = *transiens*, M'Coy. ?

11. „ CONVOLUTA, Phillips, Geol. of York., pl. ix., fig. 7, 1836. and Dav., pl. v., figs. 2—15 = (?) *rhomboidea*, Phillips. I have still some misgivings relative to this species and its supposed synonym; but three or four true examples of the typical *S. convoluta* have come under my observation, and it will be very desirable for us to ascertain whether Phillips' species may not be a very transverse or exceptional condition of *Sp. bisulcata*, Sow.

12. „ GRANDICOSTATA, M'Coy, Brit. Pal. Foss., pl. iii., D., fig. 29, 1855: and Dav., pl. v., fig. 38, 39, and pl. vii., fig. 7—16.

N.B.—All these forms appear to be nearly related.

13. „ LAMINOSA, M'Coy, Synopsis Carb. Foss. of Ireland, pl. xxi., fig. 4, 1844: and Dav., pl. vii., fig. 17 —22 = *tricornis*, De Koninck. This appears to be a very good species, but is rarely found in good condition in our English or Irish localities.

14. „ CUSPIDATA, Martin, sp., Trans. Lin. Soc., pl. iii., figs., 1—6, 1796: and Dav., pl. viii., 19—24: pl. ix., figs. 1, 2 = *simplex*, M'Coy, not of Phillips.

15. „ DISTANS, Sow., M.C., tab. 494, fig. 3, 1825: and Dav., pl. viii., fig. 1—17. I have never met with any example in which the deltidium was completely preserved, but from the inspection of an internal cast from the dolomitic carboniferous limestone of Breedon it would appear that *Sp. cuspidata* possessed a circular foramen in its deltidium, as in Dalman's *Cyrtia*, to which these two species probably belong.

16. „ MESOGONIA, M'Coy, Synopsis, pl. xxii., fig. 13, 1844: and Dav., pl. vii., fig. 24. This is said by Prof. de Koninck to be a good species, but I have never had an opportunity of studying the shell.

N.B.—*Sp. bicarinata*, M'Coy, Synopsis, pl. xxii., fig. 10: *Sp. decemcostata*, M'Coy, fig. 9, and *Sp. sub-conicus*, Martin, Pet. Derb., tab. xlvii., fig. 6—8, 1809, are very doubtful species, and cannot be accepted without further research.

17. „ REEDII, Dav., pl. v., fig. 40–47.

18. „ TRIRADIALIS, Phillips, Geol. York, pl. x., fig 7: and Dav., pl. ix., fig. 4–12. = *trisulcosa* and *sexradiales*, Phillips.

19. „ PINGUIS, Sow., M.C., tab. cclxxi., 1820: and Dav., pl. x., fig. 1–12 = *rotundata*, Sow. (not Martin) = *subrotundata*, M'Coy. I should have preferred adopting Sowerby's name, *rotundata*, for the species; but, as that name had already been employed for another species, I felt compelled to adopt that of *pinguis* for the species. The form *rotundatus* is the normal condition of the species; the var. *pinguis* is composed of shells that have been either stinted in their development, or are monstruosities.

20. „ OVALIS, Phillips, Geol. of York, pl. x., fig. 5: and Dav., pl. ix., figs. 20 – 26 = *exarata*, Fleming (?) = *hemisphærica*, M'Coy.

21. „ INTEGRICOSTA, Phillips, Geol. of York, pl. x., fig. 2: Dav., pl. ix., figs. 13–19?=*rotundata*, Martin ?=*paucicostata* ? M'Coy.

N.B.—The species composing this little group are all very nearly connected, indeed, it is at times very difficult to distinguish some of the varieties of the three last named one from another, although the generality of specimens appear to be tolerably distinct.

22. „ RHOMBOIDALIS, M'Coy, Synopsis, pl. xxii., fig. 11, 1844: and Dav., pl. xii., fig. 6, 7.

23. „ GLABRA, Martin, Pet. Derb., pl. xlviii., 9, 10, 1809: and Dav., pl. xi., figs. 1 – 9, and pl. xii., fig. 1–5 = *obtusa* and *oblata*, Sow. = *linguifera*, *symmetrica*, and *decora*, Phillips. The varieties presented by this species are endless, so that one can hardly discover a single permanent distinguishing character.

24. „ URII, Fleming, Brit. Animals, p. 376, 1828: and Dav., pl. xii., fig. 13, 14.

25. „ CARLUKIENSIS, Dav. pl. xiii., fig. 14, 1857.

26. „ LINEATA, Martin, Pet. Derb. tab. xxxvi., fig. 3, 1809: and Dav., pl. xiii., fig. 1–13. = *imbricata*, Sow. = *reticulata*, M'Coy = *elliptica* and *mesoloba*, Phillips. Some authors consider *Sp. elliptica* and *Sp. lineata* as specifically distinct.

27. SPIRIFERINA CRISTATA, Schl. var OCTOPLICATA, Sow., M.C., tab. lxii., fig. 2–4, 1827: Dav., pl. vii., figs. 37 – 47.

28. ? INSCULPTA, Phillips, Geol. York, pl. ix., fig. 2, 3, 1836: Dav., pl. vii., fig. 48, 55 = *crispa*, De Koninck (not of Linnæus) = *quinqueloba*, M'Coy.

? 29. ? MINIMA, Sowerby, M.C., tab. ccclxxvii., fig. 1, 1822: and Dav., pl. vii., figs. 56 – 59. I have never seen more than Sowerby's own two examples of this shell, and I consider it to be an uncertain species, as well as the *Sp. partita* of Portlock, which is probably nothing more than a synonym of one of those above-mentioned.

30. CYRTINA SEPTOSA, Phillips, Geol. of York, pl. xi., fig. 7, 1836: Dav., pl. xiv., fig. 1–10, and pl. xv., fig. 1, 2. This is a very interesting species, but rarely found with the two valves united. Some of the interior details of the smaller valve are still unknown.

31. „ DORSATA, M'Coy, Synopsis, pl. xxii., fig. 14, 1844: and Dav., pl. xv., fig. 3, 4. I consider this to be among the uncertain species, only two or three imperfect specimens having been hitherto discovered.

32. „ CARBONARIA, M'Coy, British Palæozoic Fossils, pl. iii., D., fig. 12–18, 1855: and Dav., pl. xv., fig. 5–14.

33. Athyris plano-sulcata, Phillips, Geol. York, vol. ii., pl. x., fig. 15: and Dav., pl. xvi., fig. 2–13 and 15 = *oblonga*, Sow. = *paradoxa* and *obtusa*, M'Coy.
34. ,, lamellosa, L'Eveillé. Mémoires de la Soc. Géol. de France, vol. ii., p. 11, figs. 21–23: and Dav., pl. xvi., fig. 1, and pl. xvii., fig. 5–6 = *squamosa*, Phillips.
35. ,, expansa, Phillips, Geol. of York, vol. ii., p. 220, pl. x., fig. 18: and Dav., pl. xvi., fig. 14, 16, and 18, pl. xvii. fig. 1–5.
36. ,, Roissyi, L'Eveillé, Mém. Soc. Géol de France, vol. ii., pl. ii, fig. 18 – 20 = *fimbriata* and *glabristria*, Phillips = *depressa*, M'Coy.
37. ,, globularis, Phillips, Geol. of York, vol. ii., pl. x., fig. 22.
38. ,, subtilita, Hall, in Howard's Ex. of the Valley of the great Salt Lake of Uta, pl. ii., fig. 1: and Dav., pl. 21–22.
39. ,, ambigua, Sow., M.C., tab. 376 = *sublobata*, Portlock = *pentaedra*, Phillips.
40. Athyris? gregaria, M'Coy, Synopsis, pl. xxii., fig. 18: and Dav., pl. xv., fig. 27 and 28. I have never had the opportunity of studying a perfect example of this shell, and I am even uncertain as to its genus.
41. Retzia radialis, Phillips, Geol. of York, vol. ii., pl. xii. fig. 40–41.

Descriptions and figures of all these species and of their varieties will be found in the portions of my work relating to the Carboniferous Brachiopoda, published in the volume of the Palæontographical Society for the years 1856, 1857, and 1858; but as this Monograph cannot be completed before two or three years, on account of the great number of plates that will be required, the Author will feel greatly indebted towards all those who may feel disposed to assist, by communicating their observations and material.

EXPLANATION OF PLATE XII.

1. Spirifera striata, Martin, from which a portion of the shell of the smaller valve has been removed, in order to show the back of the spiral cones, and their attachment.
2. ,, *Schrenkii*, Keyserling. Interior of the smaller or *dorsal* valve, with one of the spiral cones *in situ*, the other having been removed so as to expose the muscular impressions. A A, adductor, or anterior and posterior occlusor muscle of Hancock. J, Cardinal process, to which was attached Mr. Hancock's divaricator, or cardinal muscle. *t*, sockets for the reception of the teeth of the opposite valve.
3. ,, *Schrenkii*, Keyserling. Interior of the larger or *ventral* valve. D, pseudo-deltidium. *t*, teeth. A, impressions left by the adductor or occlusor muscle. R, of the cardinal or divaricator muscle. Several instructive fragments of the interior of this species were figured and described by Count A. Von. Keyserling in Dr. Schrenk's Russian work "die Tundren der Samojeden."
4. ,, *Cyrtæna*, Dalman, interior of the ventral valve.
5. ,, *Anossofi*, Verneuil, ,, ,,
6. ,, *Mosquensis*, Fischer, ,, ,,

These last three figures are here drawn to explain modifications in the shape and development of the diverging dental or rostral plates.

7. Cyrtia *trapezoidalis*, Dalman. Interior of the ventral valve, to show that the diverging dental or rostral plates are similar to those of *Spirifera*, but essentially different from those of *Cyrtina*. D, pseudo-deltidium; F, foramen.

8. ,, *cuspidata*, Martin, viewed in profile, and from which a portion of the valves have been removed, so as to exhibit the two diverging dental or rostral plates.

9. Spiriferina *rostrata*, Schlotheim, from which a portion of the smaller valve has been removed, so as to show the back of the spiral cones, as well as the position of the central plate of the larger or ventral valve.

10. ,, *rostrata*. Interior of the ventral valve, exhibiting the large vertical median plate, or septum, to which was attached the adductor or occlusor muscle. R, ventral adjustor. The two plates composing the pseudo-deltidium are here clearly defined.

11. Suessia *plicata*, E. Deslongchamps. Interior of the dorsal valve, in which the cardinal process and largely-developed hinge-plates are well exhibited; no perfect interior of this genus has, however, been obtained, so that the spiral appendages could not be represented. A good illustration of the larger valve is likewise among the desiderata, although some of its characters have been described and represented by Mr. E. Deslongchamps.

12. Cyrtina *heteroclyta*, Defrance. Interior of the ventral valve, to show the large single median septum, to the upper surface of which were attached dental or rostral plates; a small portion of the arched pseudo-deltidium has been removed.

13. ,, *Demarlii*, Bouchard, to show that in this species the median septum extends to the roof of the arched pseudo-deltidium, the dental plates being fixed to the sides of the septum, instead of the upper edge, as in *C. heteroclyta* and *C. septosa*. The perfect interior of the smaller or dorsal valve of no species of *Cyrtina* has been hitherto discovered.

14. Athyris (M'Coy) = Spirigera (d'Orb) *pectinifera*, J. de C. Sowerby. Interior of the dorsal valve, and of a portion of the ventral one, magnified. The hinge-plate, and its small circular aperture, as well as the spirals and their complicated connecting processes, are here represented; but the spiral cone on the right side has been somewhat displaced from its natural position in order to better explain the connecting system of lamellæ. The hinge of both valves is also here seen, as well as the rostral plates and foramen of the larger or ventral valve.

15. ,, *concentrica*, Von Buch. Interior of the ventral valve; the adductor A, and divaricator muscular impressions R, are here clearly defined.

16. Merista *Herculea*, Barrande, to show the shoe-lifter-shaped process H, first described by Prof. King.

17. ,, *tumida*, Dalman. Interior of the dorsal valve. Although much labour has been bestowed by Prof. Suess in working out the interior character of his genus, a correct restored representation of the interior has still to be produced; the one here given is not sufficiently detailed or precise.

18. ,, Interior of the ventral valve.

19. ,, *scalprum*, Rœmer. Exterior of the ventral valve, in which the two diverging lines due to the dental plates are seen, as well as the hollow under the shoe-lifter process or plate.

20. Retzia *serpentina*, de Koninck, from a drawing by Mr. S. P. Woodward; no perfect representation of the interior of either valve has been hitherto produced, and all we know is, that the specimens composing the sub-genus were provided with spiral processes.

21. Trematospira, Hall?
22. Nucleospira, Hall?
I do not possess material to enable me to illustrate these genera? but it is to be presumed that Mr. Hall will, ere long, supply this deficiency.

23. Uncites *gryphus*, an imperfect representation of the interior of a portion of both valves, showing the position of the pouch-shaped expansion (*g*), and the attachment of the lamellæ, which are supposed to have formed the spiral cones. A fragment has been added from another specimen, in which are seen traces of spiral lamellæ; but a more perfect representation of these processes, and of the muscular impressions in both valves, has still to be produced.

24. ,, *gryphus*. Profile view of the same, a portion of the shell having been removed, so as to show that the pouch-shaped depressions did not communicate with the interior of the shell.

25. ,, *gryphus*. A specimen to show that in the young state the shell was moored to marine objects by the means of a peduncle issuing from a perforation or foramen in the beak of the ventral valve.

26. Atrypa, Dalman = Spirigerina, d'Orb, *reticularis*, Linnæus. Interior of the dorsal valve, showing the natural position of the vertical spiral cones.

27. ,, Interior of the ventral valve, F, foramen; D, deltidium; T, teeth; A, adductor or occlusor; R, ventral adjustor muscular impressions.

28. ,, Specimen from which the larger portion of the dorsal valve has been removed in order to show the back of the spiral cones.

29. ,, Interior of the dorsal valve, from which the spiral lamellæ have been removed, so as to exhibit the impressions of the adductor or anterior and posterior occlusor muscles.

30. Anoplotheca *lamellosa*, Sandberger. Fragment showing the vertical spiral cones.

31. ,, Internal cast of the dorsal valve. A, impressions left by the adductor or anterior and posterior occlusor muscle; J, cardinal process.

32. ,, Internal cast of the ventral valve. Figures, 30, 31, and 32 are taken from Dr. Sandberger's Paper, published in 1855 by the Academy of Vienna; but it is to be regretted that the material hitherto discovered has not enabled the proposer of the genus to give us a more perfect representation of the spiral appendages.

33. Davidsonia *Verneuilii*, Bouchard. Interior of the dorsal valve (enlarged). J, cardinal process; *t*, sockets; A, A, impressions left by the adductor or posterior and anterior occlusor muscle. A restored representation of the spiral lamellæ recently discovered by Prof. de Koninck has been added on one side.

34. ,, *Verneuilii*, Interior of the ventral valve, showing the teeth, pseudodeltidium, adductor and divaricator muscular impressions, as well as the massive cones and vascular impressions.

35. Koninckina *Leonhardi*, Wissman. A translucid specimen made thinner by acid, and seen from the exterior of the ventral valve, by which means the position of the spiral lamellæ has become visible.

36. ,, *Leonhardi*. Interior of the dorsal valve, with a portion of the spiral lamellæ preserved. These two illustrations are taken from drawings sent me by Prof. Suess.

Note.—Since the publication of the tenth No. of the Geologist, I have received, through the kindness of Mr. Burrow, of Settle, in Yorkshire, a great number of fragments of *Cyrtina septosa*, and was happy to find among them the internal cast of the smaller or ventral valve, showing that the muscular impressions were exactly similar to those observable in *Spirifera;* no septa existed in this valve, so that the shell cannot be classed with *Pentamerus.* None of the fragments, however, exhibited a trace of spiral processes, but this is no proof that they might not have existed. The terms *Athyris* and *Atrypa* have been made use of in this paper, but I wish it to be distinctly understood that I do not recommend their adoption. I used them as mere names, and on account of their priority of date; but, as the generality of naturalists on the Continent, and some in Great Britain, have for some time past made up their minds to repudiate both M'Coy's and Dalman's misnomers, for the reason that they involve a zoological mistake, my readers can adopt M. d'Orbigny's substitutes of *Spirigera* for Athyris, and *Spirigerina* for Atrypa, although other denominations might have been preferable.

ERRATUM.

In page 412, line 19, instead of genus Atrypa, Dalm. = Spiri*f*erina, D'Orb., *read* Spirigerina, d'Orb.

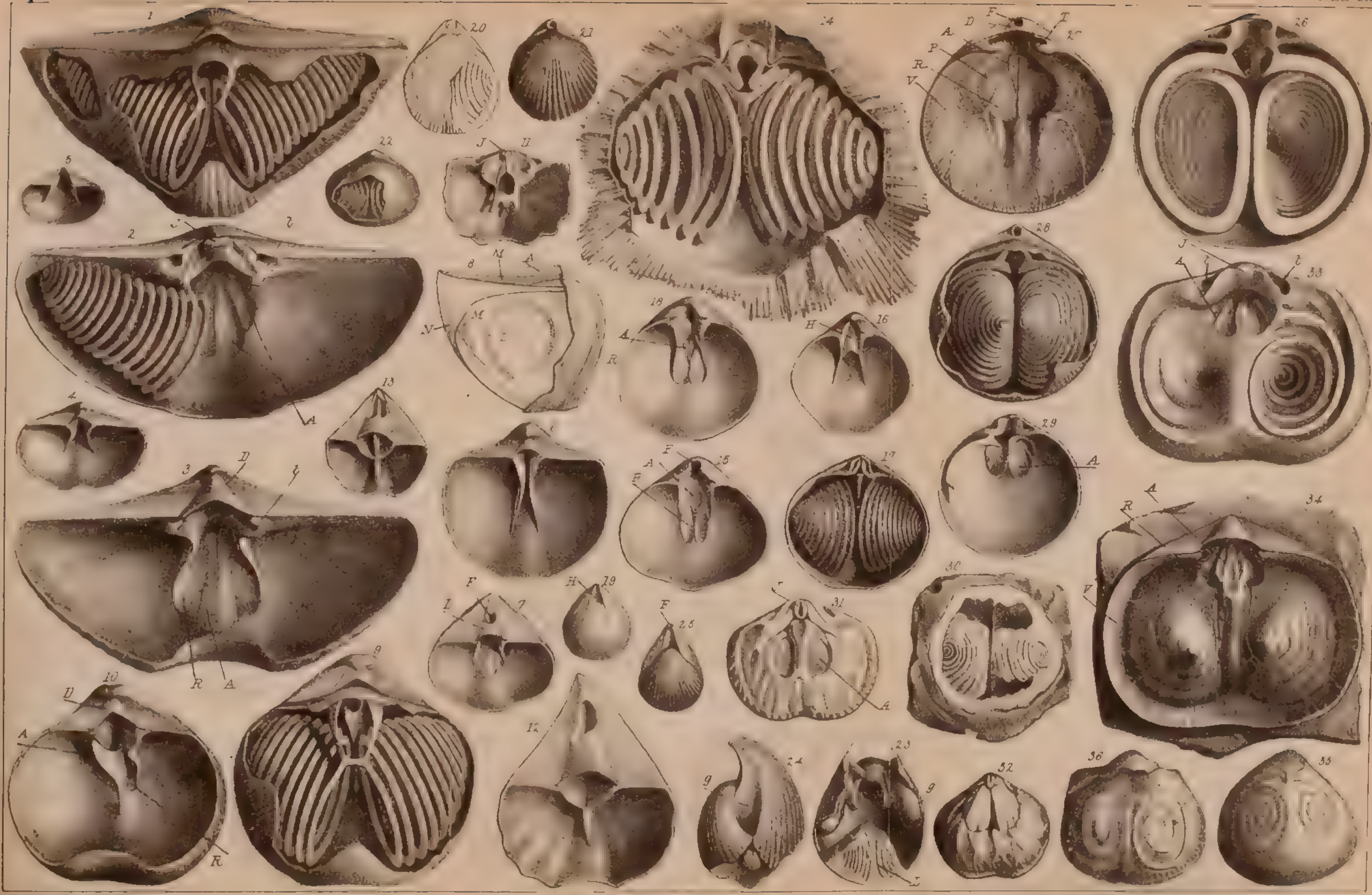
THE COMPARATIVE GEOLOGY OF HOTHAM, NEAR SOUTH CAVE, YORKSHIRE.

By the Rev. T. W. Norwood, of Cheltenham.

(*Continued from page* 424.)

II. It is about a mile across the Lower Lias, on which the villages of North Cave and Hotham are situated, to another gently-rising ground which ascends out of Hotham Park to the eastward in a beautiful sloping bank, and being tastefully planted with stately trees, contributes very much to the charm of the scenery. Coming in with my hammer to the ancient village, in the bright and odorous evenings of midsummer, I have often been arrested by the sweetness of this place; and, enamoured of its serene and peaceful beauty, I have loitered to admire its dark plantations, and the greensward slope that I am now describing, and the illuminated wold rising high in the distance. It is the low escarpment of the Middle Lias which declines thus pleasantly into the park at Hotham. As we go out of North Cave towards Beverley, this bank may be observed to rest upon soft blue shales, which have hitherto supplied no fossils. When we begin to ascend it, we may turn into a copse on the right-hand side and study the section in a marl-pit, or we may notice the roadside cutting. In either case, we shall observe that the beds change as follows:—From blue shales at the bottom and lower part of the ascent, through brown earthy-looking shales and sand with irregular broken bands of nodular clay-ironstone, one of which enclosed

Plate I.



Thos Davidson del & lith

a cast of *Unicardium cardioides,* to a hard rock-bed of the true *Marlstone,* two or three feet in thickness, which again is capped at the top of the ascent by a very rusty, rubbishy, and ferruginous rock. It is in the last division only that I have succeeded in obtaining fossils at this place in any quantity worth mentioning; and they are always in a very corroded and imperfect condition. The most plentiful forms are *Belemnites,* and next to them, masses of *Rhynchonella tetraedra*; but with perseverance and good fortune *Terebratula resupinata* and other characteristic shells of the Middle Lias may be collected here. This zone may be traced both towards the north and south, though it does not maintain that upland character which it assumes in Hotham Park, for more perhaps than two miles of its course. It is seen in one direction, near Hotham, as we leave that village by the road to Beverley; in the other it crosses the turnpike at Everthorpe, and passes close by the castle and church of South Cave. There is a moory valley with a surface of sand and peat lying along on the north side of Hotham towards Newbald, between the escarpment of the Lower Lias on the one hand and the rise of the chalk-wold on the other; a favourite haunt, in spring and summer, of lapwings and sand-martens. Two pits, which were opened in this valley for marling, about a mile from Hotham church, have exposed a substratum of remarkable drift which is very well deserving of examination. It consists of a medley, in great masses more or less rounded, of all the surrounding formations, from the "Posidonomya-bed" to the White Chalk, and contains some organic remains distinctive of rocks which are not known at present to exist *in situ* anywhere in the neighbourhood of Hotham. For example, it has supplied an *Ammonites cordatus,* with a matrix of Oxford clay, which leads me to suspect that that rock might be found stratified no great way off, especially as the Kelloway rock occurs in its place hardly more than a mile to the eastward. The fact, too, that the formations composing this drift lie mostly to the westward of their proper lines would indicate that the great transporting waters which accumulated these ponderous and disordered masses had their origin in some eastward direction. Mixed indiscriminately in the general ruin lie large and small blocks of *Middle Lias Marlstone,* dissimilar, however, in colour and texture to the marlstone which I have mentioned as cropping out near North Cave, and which may also be traced through Everthorpe and South Cave in its progress towards the Humber. The colour of these rocks is more darkly ferruginous and their texture markedly oolitic or granular, though not unfrequently they change to a deep green hue, imparted to them by the protoxide of iron, when the granular structure becomes less observable. The fossils, also, which they enclose, though exceedingly distinctive and familiar, have not yet been found *in situ* at Hotham. They are the common forms of the true Marlstone—the "Spinatus" and "Margaritatus" zone of Oppel and Wright—which is shown in typical sections, as at Gretton, near Winchcombe, in Gloucestershire, to occupy the top of the Middle Lias in the southern counties. I collected here the large *Pecten equivalvis* and *P. corneus*, both of which were plentiful as usual, *Belemnites*, *Pleuromya unioides (?)*, *Cardinia crassissima*, and *Ammonites Englehardti*, with some others. The drift which I have been now considering contrasts remarkably, from its mixed character, with those other and almost homogeneous deposits which have been shown to cover the neighbourhood of North Cave.

III. It may be about 200 yards across the Middle Lias; but its junction with the rock next succeeding is not well exhibited. The country is now flat to the foot of the chalk, and the sequence of the different rocks that traverse this level is partly undeterminable from lack of sections, and partly obscured by drift, so that I could not make it out with sufficient exactness. I ascertained, however, that the ferruginous beds give place to an inconsiderable band of yellow tenacious clay; and that this again is apparently succeeded by a still narrower zone of very peculiar marly limestone, which I shall call provisionally the LIGNIFEROUS MARL, and describe as fully as my present materials will permit. I regret that these are not more ample, which is owing, in part, to my limited opportunities. I believe this to be an exceptional bed, possibly it may even be unknown hitherto, and unrecorded in our series. Its lithological character might refer it to the Upper Lias; but its fossils in general, and particularly in one or two instances, are much more of Oolitic than Liassic types; and consequently I should be inclined, in the existing state of my knowledge, to assign it an intermediate place between the Upper Lias and Inferior Oolite, somewhere in that "debatable ground" which has lately received such elaborate illustration from Dr. Wright. I have reason to suspect the existence of the *Upper Lias Clay* at Hotham; and I shall hope to prove that I have seen there the lower portion of the *Inferior Oolite*, a little above this *Marl;* but, until the relative places of these rocks are accurately known, I desire to speak with great reserve of the horizon and affinities of the "Ligniferous Marl;" and shall better employ myself in discussing its appearance, so far as I have really seen and studied it, in the hope that I may induce some geologist with more leisure and experience to go down to Hotham and complete the investigation. A small opening made this year for road-stone, in the lane-side between Hotham and the Drewton turnpike, exhibits the place, breadth, and character of this limestone. Its position might argue it at first sight to be "Upper Lias;" its width is but a few yards; and structurally it is a band of sharp irregular uncompacted stones, which may be divided, not naturally but for convenience of description, into two kinds. Those of what I shall call the first sort are comparatively soft and marly, of a yellowish-grey colour and general fresh-water aspect, interspersed throughout with fragmentary remains of land-plants, particularly of a *fern,* with a frond-lobe much resembling in outline that of the common Polypody (*Polypodium vulgare*). The venation is generally distinctly preserved: the lobe has a prominent mid-vein, from which alternately, on either side, branch out the lateral veins, these last being twice-forked and thus divided into four branches. I am indebted to Professor Phillips for pointing out, when I lately read a paper on this subject before the British Association at Leeds, the affinities of this fern in general; and the interesting fact which I had omitted to notice, that one specimen in my collection shows its fructification. It may probably appear that the occurrence of this fern is among the first indications in the Yorkshire strata of a series of acrogenous plants which attained to much importance afterwards, and which have been long known to us in the "Upper and Lower Sandstone, shale, and coal" of the "Geology of Yorkshire." Portions of stems occur also in this marl, but perhaps less frequently than leaves of plants.

In another division of this bed, the rock becomes harder and not so marly. It changes imperceptibly to a bluish-grey colour, and is a very useful road-metal, having a sharp splintery fracture, and a clear ringing sound under the hammer. I have adopted this conventional distinction, because I have remarked as a general rule that the wood is found mostly in the softer, and the fossil animals in the harder part; not but that these often run together, and admit of no line of separation at all. In acquainting myself with the organic remains of this rock, I found it most advantageous to work at the stone-heaps by the roadsides where it has been broken into small pieces, rather than at the quarry where some of it is not very frangible, and where it is all ill-exposed. This will both save labour and prevent disappointment. Very few genera of animals are represented in it, and scarcely any genus by more than a single species; but the individuals are numerous, and so singularly persistent and distinctive in their forms that no better defined species could be desired. A small sea-urchin is very abundant and characteristic, but hitherto I only know it as an interior mould and cannot safely determine its genus. It is either an *Acrosalenia* or *Pseudo-diadema;* but though I have collected as many as twenty or thirty specimens in a morning I am in almost total ignorance about the test. Once, too, and only once, I met with a trace of another and larger urchin in the shape of a bit of an impression of (?) a *Pedina* or *Hemipedina.*

Thus there is a fair field at Hotham for any person interested in the *Echinoidea;* and this last specimen may probably prove to be a new species. But some patience will be required for a successful hunt after these tantalizing little animals, whose shells, according to my experience, are very difficult to be met with.

Pinna, *Modiola*, and *Pecten* are the principal genera of shells; and each has a single prevalent species. I shall not pretend to have ascertained these species. I neither know them myself nor can as yet obtain any reliable information respecting them. The whole zone is strange to me; and while I am desirous to describe it as fully as I can, there is much in it that I must leave for the present undecided. Any palæontologist, being at Hotham, would have no trouble in collecting these shells; and I should be glad to show such as still remain in my possession to any geologist visiting Cheltenham.

In the miscellaneous drift-bed to the north of Hotham, which I discussed when speaking of Middle Lias, there occurs a rock so exactly resembling the "Ligniferous Marl" in appearance, that I had, till lately, no doubt of their identity, though I missed from it my fern-leaves, urchins, and mollusks. And when I found in it that typical-shell of the Upper Lias, *Ammonites communis*, and a faint impression of another Ammonite which seemed to be *A. Lythensis*, I came fully to the conclusion, for the time, that my "Ligniferous Marl" was an

"Upper Lias" bed. I suggested, on this evidence, that it was probably such at the Geological Section at Leeds. My opinion, however, has since been shaken by the discovery, among my Hotham fossils, of a specimen of *Hinnites abjectus*, the matrix of which leads me strongly to suspect that it was obtained from the "Ligniferous Marl." It is, then, for these reasons that I desire to leave that zone altogether *sub judice* until I can see it again, or until it shall be seen by some more competent person. As to the conditions of its deposit—judging from the unbroken state of *all* its organisms, small and frail as many of them were, with the *single* and remarkable exception of its rolled and fragmentary remains of land-plants, and reasoning from analogy about the habitats of the fossils themselves during life, it would appear that this bed was very tranquilly laid down in a shallow sea, near the mouth of some ancient river which watered a land with a genial climate, and bore away, amid the spoils of its banks and jungles, a fern related to the common Polypody.

IV. Proceeding from the "Ligniferous Marl" pit towards Drewton, we immediately come upon a thin bed of chalk-drift, which conceals the contact of the subjacent rocks, and arrive, in about 100 yards, as nearly as I can remember, at a large *Oolitic* quarry on the right-hand side. I am at present unable to say by what kind of transition the marl-band passes into this very dissimilar Oolitic rock; but obviously this is a point which it would be very interesting to clear up. "Hotham Quarry" is one of many more such like, which follow the line of these oolites northwards from the Humber, and were, no doubt, opened originally for the erection of the neighbouring villages and churches, the last being chiefly of Norman foundation. Several of these old quarries have been partially filled up and brought again under the plough in recent times; as is the case with those at Drewton, which, with one inconsiderable exception, are now only to be traced by inequalities in the ground. For the most part, however, they remain open still; and, where they are not grass-grown but continue in use for the roads or for lime-burning, they afford excellent facilities for geological examination. It is possible that they might be found, upon a survey, to be situated in different Oolitic zones; and so would require to be studied for some distance north and south, in order to obtain a full and perfect exposition of the Oolites at Cave. Hence it will be necessary for me to confine myself in this description, with very little deviation, to the path which I have chosen through the village of Hotham, nearly at right angles to the direction of the strata. The Oolites along my route commence at Hotham Quarry with what I believe to be the lower portion of the *Inferior Oolite;* for it answers, with considerable exactness, lithologically as well as zoologically, to the "Pisolite" or "Roestone" of the neighbourhood of Cheltenham, which has been hitherto affirmed to be a local formation limited to that special vicinity. They end, after a breadth of about three-quarters of a mile, where the Kelloway Rock is succeeded by the Red Chalk under the edge of the wold at Drewton,—both of these deposits being very rich in their distinguishing forms of organic remains, and corresponding to their equivalents in Wiltshire and Norfolk. I shall confine myself, therefore, in this paper to the geology of Hotham, and to stating, as summarily as possible, my reasons for thinking that Hotham Quarry is in the *Inferior Oolite*—a formation which, therefore, is not wanting in this long uncertain district of Cave, though its appearance here is somewhat strange and degenerated, and implies a peculiarity in its deposit.

The Hotham Oolite, in the Upper part, is a white-coloured, thin-bedded rock, coarse and fissile, and of a decided "roe-stone" aspect, which, somewhat lower, becomes largely intercalated with layers of sand, and is seen at the base of the section, which is probably nowhere twenty feet deep, to have become altered into a thick-bedded sandy freestone. Its fossils cannot be said to be plentiful. Most frequently we find broken remains of Echinodermata, such as occur in the "Pisolite" of the Cheltenham Inferior Oolite; and, so far as I am a judge of the associated mollusca, they go to confirm the testimony of the urchins, and the evidence from "pisolitic" appearances. I subjoin a list which I have succeeded in collecting, not without a good deal of attention and perseverance; and, like all other fossils recorded in this paper, they were obtained (with the exception of one) with my own hands. Undoubted specimens, generally in bad preservation, of *Pygaster semisulcatus*, which is perhaps the most common form of all; a large flat *Clypeus*, so like at first sight to *Hyboclypus agariciformis* as to deceive an experienced eye, but distinguished upon close inspection by the character of the ambulacra and poriferous zones—I consider it to be the *Clypeus Michelini* of Wright, but I have never found a good and sound example of it, although bits of its test are not rare; a cast of (?) *Acrosalenia ;* a species of *Pseudodiadema*, (not *depressum*,) only known at present in a mould with a small remnant of the test upon it; slabs with *plates and spines of urchins*, *Pentacrinites*, and *Millepores ; Hinnites* *abjectus* and *H. velatus*; *Lima duplicata*; *Pecten demissus*; a small variety of *Trigonia costata*; a large flat *Pinna*; and species of *Ostræa*, *Modiola*, and *Nerinæa*.

Mr. Lycett, however, has recorded his opinion that "perhaps the genus *Nerinæa* has not been found in any deposit older than the *Oolite-Marl*."

I am disposed to attach considerable stratigraphical importance to the well-ascertained occurrence of *Pygaster semisulcatus* at Hotham quarry, because Dr. Wright, than whom there is no higher authority on the question, has said in his great "Monograph on the Oolitic Echinodermata" that "it is extremely doubtful whether *Pygaster semisulcatus* has been found as yet out of the English Inferior Oolite;" and he adds that two distinct species of the genus Pygaster exist in the Oolites in Yorkshire—viz., one collected from the Inferior Oolite of Whitwell, and the other (*P. umbrella*) from the Coralline Oolite of Malton. Assuming, then, on this testimony, that the Inferior Oolite is found at Hotham, it appears to be bounded approximately towards the east by the high-road from South Cave to Market Weighton, just beyond which another rock crops out in a sand-hole. In the large quarry belonging to North Cave, which may be found near "Castle Farm," adjoining that of Hotham, the stone seems more brecciated, and its fossils are very fragmentary. Its slabs are overlaid with Millepores and débris of Echinodermata.

The small hole which yet remains at Drewton, and is used for burning lime, has much the same lithological character which I have ascribed to the beds at Hotham; it is sandy and comparatively unfossiliferous, and its place is some distance to the west of the turnpike, nearly in a line with the two larger pits aforesaid. I collected there, after much trouble and several inspections, a well-preserved *Pseudodiadema depressum* in no way distinguishable from Cotswoldian Inferior Oolite specimens, and a piece of *Pygaster semisulcatus*. This convinced me that I was still in the Hotham zone; and I could detect no change in the rubbish on the ploughed lands till I reached the high-road.

It will no doubt be thought that this zone presents but a very scanty fauna in comparison with the Cotswold Pisolites. And indeed there is a marked absence of many things which might have been expected, particularly of the *Brachiopoda*. I suspect, then, from the quality of the rock itself, the state in which its fossils are found, and the striking dearth of deep-water remains, that we may have here a brecciated and littoral condition of the Inferior Oolite sea; which is perhaps not contrary to what weshould expect when we remember the peculiar character of the "Ligniferous Marl" below. This completes what I have to say about the Geology of Hotham, to which I propose to restrict myself for the present.

DESCRIPTION OF THE SECTION OF THE UPPER GREENSAND AT THE UNDERCLIFF, IN THE ISLE OF WIGHT.

By Mr. Mark W. Norman.

As the practical value of local details is admitted by all geologists, I have contributed the following statement of the Upper Greensand strata strata in the Isle of Wight, thinking it might prove of interest to the readers of the Geologist.

The following table will convey at a glance the relative position and thickness of the beds, and will serve to make the general observations more readily intelligible:—

SECTION OF THE UPPER GREENSAND.

Sub-division.	Vertical Scale in Feet.	
Grey Chalk or Chalk Marl.		
Lower Chalk or Chalk Marl.		
Upper Greensand.		
1—Phosphatic Marl - - - - - - -	1	Very fossiliferous.
2—Chloritic Marl - - - - - - - -	3	Fossiliferous.
3—Great Chert Bed - - - - - - -	6	Fossils. One of the beds of chert contains fossil coniferous wood, silicified.
4—Rag or blue limestone, and sandy beds and cherty sandstone ..	24	Bones of Saurians.
5—Firestone - - - - - - - - - -	27	Fossils.
6—Freestone beds, alternating with blue rag - - - - - - - -	31	Fossils rare. Those found are chiefly Pectens, and are well preserved.
7—Sandstone beds, containing sandy concretions, with beds of rag, including the "Whill Rag," and terminating with the "Big Rag Bed." - - - - - - -	39	Fossils. *Siphoniæ*, *Ammonites*, *Gryphææ*, *Serpulæ*, *&c.*
8—"Malm Bed," consisting of beds of tough sandstone, with layers of rag in detached masses or nodules - - - - - - - -	52 to 60	Fossils. *Ammonites*, *Echinites*, *Astacus*, *&c.*
9—A thick layer of sandy concretions, mottled with black, and differing both in texture and substance from the beds above, the lower portion of which is termed the "Rubble Gault." - - - - -	to 109	Fossils. *Lima*, *Inoceramus*, *Serpulæ*, *&c.*
Gault - - - - - - - - - - -		

Note.—The figures in the first column denote the average thickness of the beds described; the second column gives the total thickness of the whole series.

1st. The upper portion of the section is subdivided into two parts, being in fact two distinct deposits, differing materially in mineral character, and almost distinctly in their organic remains; for instance, the first division contains numerous species of Ammonites, amongst which the most conspicuous are *A. varians*, *A. Mantelli*, and *A. Coupei* in all its varieties, with numerous other shells that never occur in the Firestone below, or, indeed, in any other of the beds throughout the series, although they are met with in the chalk-marl above, to which it evidently approximates, being of a much lighter colour than the beds below. It is termed the "Phosphatic marl." The organic remains are for the most part water-worn, and exist in the state of casts, especially the Ammonites, which are so numerous that, judging from the profusion of their remains, they must have literally swarmed in the sea of that period.

2nd. At the bottom of the before-mentioned deposit, we come upon a bed of fantastically-shaped nodules, varying in size from a few inches in diameter to a foot, amongst which may be found the water-worn remains of a gigantic bivalve, termed "Radiolites," teeth and bones of Saurians, hook-shaped teeth, &c.

Below this, again, is a thick bed of dark-green, soft sandstone, readily weathered. This bed I believe to have been named the "Chloritic marl," by geologists. At the bottom of it is another layer of nodules, similar in character to those above, containing also the teeth and bones of saurians as well as of sharks, with other fossils, the most characteristic being the *Pecten orbicularis*, which abounds.

3rd. The next division consists of layers of siliceous sandstone and beds of rag, alternating with beds of coarse, brittle, flinty masses, or coarse chalcedony, locally termed "shotterwit," which is much used for the making and mending of roads, as is also the limestone or rag. It is very brittle, and easily broken into square fragments; and is almost destitute of organic remains, but the large *Pecten quinque-costatus* is sometimes, though rarely, found; but, being imbedded in a flinty matrix, it is seldom extracted whole. The same shell also ranges through the four alternate layers of rag and chert, but the writer has met with no other fossil remains, except coniferous wood.

4th. The next beds in descending order consist of hard, brittle stone, spongy in texture, and strongly impregnated with silex, breaking, like the preceding, into square fragments. They are interspersed with layers of rag, and are called by the quarrymen, the "Cock-beds." The organic remains consist of sponges, zoophytes, *Pecten quinque-costatus,* and a large Terebratula, but these are sparingly found. The beds are twenty-four in number.

5th. We now come to a succession of beds of chert and sandstone. One bed, about nine inches or a foot thick, is called by the masons the Firestone, and is most probably the equivalent of the rock so-called in Sussex, and described by Dr. Mantell, who denominated the whole of the series as "Firestone," but which appears from his description to have thinned out considerably in that locality, and to have become amalgamated with the chalk-marl. Still, the fossils he describes as belonging to the Firestone at Southbourne are never met with in the Isle of Wight below the Phosphatic Greensand, nor does the chalk-marl ever appear in the whole section of the Undercliff, a distance of nine miles from Shanklin to Blackgary, below the Firestone, or Upper Greensand, as exhibited in his section of the beds near Southbourne.*

Again, at page 164, he says the "Firestone contains the same fossils as the Grey marl;" but one, at least, which he enumerates, the *Ostræa carinata,* is a characteristic fossil of the two beds, the phosphatic and chloritic greensands, capping the firestone in this locality, and is very rarely found below them. *Ammonites planulatus* also occurs higher up in the same bed, but I have never met with it in those below. I have merely mentioned these discrepancies with the view of calling attention to the fact, namely, that all the fossils which Dr. Mantell has described and figured in his work on the "Geology of the South-east of England," as belonging to the "Upper Greensand," or "Firestone," belong to the two upper beds of the "Phosphatic Greensand," and to the "Chalk Marl" in this district; whilst neither in the list there appended, nor elsewhere, has he described or enumerated any of the characteristic fossils of these deposits which occur in the Undercliff-series of the Upper Greensand, namely, the *Pecten quinque-costatus,* the large *Ammonites, Ancyloceras* (or *Hamites*), &c.

"The Fire-stone group" of Dr. Mantell includes those twenty-four beds above described, but the term is restricted in this locality to an upper bed, about eight inches thick, superimposed on a stratum of rag of a pale blue colour, tinted with red, very hard, about nine inches in thickness, and succeeded by another bed of fire-stone of the same thickness as that above, the last resting upon the "Cock-bed," of about three or four inches thick.

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* Vide, Mantell's "Geology of the South-east of England," pp. 161—164.

I consider, from my own observations, that all the fossils of the two upper beds, the "Phosphatic" and "Chloritic" marls, ought, with few exceptions, to be referred to the chalk-marl; but not those below this very clear line of demarcation. The fire-stone, when first quarried, is of a soft texture, but hardens by exposure to the atmosphere; it is fire-proof, and used by masons in fixing grates, for oven-bottoms, and other purposes where endurance of heat is an essential quality. It was from the beds of rag in this group that the fossil bone of a terrestrial animal, described at page 179 of Mantell's "Excursions round the Isle of Wight,"* was obtained in a quarry (now closed) near the Bonchurch Hotel. This relic is now in the possession of — Hanbury, Esq., and the writer of this has seen a good wheelbarrow-full of bones of an animal, apparently Saurian, dug out of the same quarry; but from their decomposed state, these were too friable to permit the preservation of a single specimen. A few teeth were secured, but, owing to this cause, they fell, shortly afterwards, to pieces by exposure to the atmophere. These remains were obtained from the lowermost bed of the "Phosphatic Greensand."

6th. The next beds in descending order are important ones in an economic point, from their great utility as a building-material, and the consequent demand for them for such purposes. Their place in the series of deposits forms a well-marked epoch or line of demarcation in the history of the "Upper Greensand;" they may be divided into five sections:—The first is a bed of grey sandstone, about one foot thick, called by the quarrymen the "Top Bed," succeeded by a layer of ragstone from eight to nine inches thick; thirdly, another bed of sandstone of about the same thickness as the rag; fourthly, a thick bed of freestone, often considered to be analogous to the Portland building-stone, but erroneously so, being different in composition and mineral character, and evidently consisting of a mixture of grains of silex and, probably, of iron, cemented by carbonate of lime; the roe-like particles of the Portland-stone being really wanting.† The fifth bed consists of the free-stone proper, averaging four feet in thickness, and being about thirty-four feet from the top of the "Upper Greensand." It is succeeded by a thick bed of darkish-blue rag, and a bed of chert, the last in the series.

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* Page 247, Editions of 1847 and 1851.

† I have mentioned this because of a popular error that exists amongst the masons and others of this locality, namely, of the identity of the free-stone with that of the Portland rock; an error which, of course, no geologist would fall into.

The 7th division has a depth of about thirty-nine feet, and is composed of thick beds of fine sandstone, alternating with beds of blue rag; it may be divided into fifteen strata. The first is a bed of yellowish sandstone, about three feet in thickness, full of a species of *Siphonia*, nodules with a sponge-like texture, remains of *Polyparia*, very large *Ammonites*, *Nautili*, and nodules of rag. Below this is another layer of rag, a foot thick, succeeded by a bed of fine sandstone of a softer nature than the one above, and extending to a depth of about three feet.

In contact with the last is a bed of tough sandstone a foot thick, locally termed the "Black-band," and containing fossils. The writer has now in his possession the claws of an Astacus (?), which must have belonged to an individual more than a foot in length. He has, besides, from this band, a species of Echinus (?).

To this sandstone several alternating bands of light sand with thin belts of the "Black-band" succeed, the whole amounting to about seven or eight feet in thickness.

Below this, again, are stratified layers with nodules, termed "Whill-Rags," in shape like a compressed cone, many of which are two feet in diameter, and most of them containing organic remains as nuclei. They are very hard and tough, and difficult to break. They are, however, much used by builders in the construction of sea-walls, and for the front-walls of dwelling-houses. On being cloven or split by the quarrymen, by means of very large wedges inserted in a hole made by a mallet and chisel, and afterwards driven in with a weighty sledge-hammer, they are often found to contain Ammonites of very large size, with the mouth entire; and a fine species of Astacus (?) is reported to have been thus obtained from one of them some years ago by Mr. Saxby. The writer has seen some magnificent specimens of Ammonites in the possession of Dr. Leeson, one of which, about sixteen inches in diameter, was obtained whilst sinking a well at Bonchurch. It is, perhaps, worthy of remark in this place that the fossils are generally found at the base of the "Whills."

(To be continued.)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

New method of obtaining Artificial Minerals and Precious Stones—White Corundum—Ruby—Sapphire—Green Corundum—Zircone—Cymophane—Gahnite—Staurotide—Silicate of Zircone—Emerald—Curious Decompositions—Action of Fluor Compounds in the Natural Formation of Minerals—Rutile—Mode of Working the Sub-Alpine Tunnel between Modane and Bardonèche—Employment of Compressed Air as a Motive Power for Boring and for Ventilation—Curious Phenomenon observed during these Works—Rate at which the Alpine Tunnel is Progressing—Thickness of the Alps—Ascent of the Maladetta and the three kinds of Granite in the Pyrenees and the Haute-Garonne.

Messrs. H. Ste. Claire Deville and H. Caron have lately published a remarkable memoir *On a new Method of producing, in a Crystalline state, a certain number of Chemical and Mineralogical Species."* It will be sufficient to state that sapphires, rubies, and other stones of the corundum kind, staurotide, cymophane, &c., have been obtained to make it immediately understood how great an interest is attached to these new investigations.

One of the most successful methods employed by those chemists, to obtain the artificial crystals in question, consists in the mutual action of certain volatile metallic fluorides on fixed or volatile oxygenized compounds. Now, as very few of the metallic fluorides are *not* able to be volatilized more or less completely, this method of experimentation is almost always applicable. We shall here enumerate successively the mineralogical species obtained by the authors, and the exact process they have employed to produce them:—

1. *White Corundum.* This substance was produced in very fine crystals by the following means:—Into a charcoal crucible a certain quantity of fluoride of aluminium is placed, over which is fixed a little charcoal cupel, filled with boric acid. The crucible, covered by its lid, and carefully protected from the contact of the atmosphere, is then heated to a white heat for about one hour—not more. The vapours of fluoride of aluminium and boric acid come in contact and mix together in the empty part of the crucible, and are mutually decomposed, producing corundum and fluoride of boron. Corundum—which, as our readers are aware, is nothing more than a peculiar state of alumina—is found, after the operation, crystallized in rhombohedrons, with the faces of the hexagonal prism. They possess all the optical, crystallographical, and chemical properties of the corundum found in nature, whose hardness they possess also.

By the above method, crystals as much as one centimetre in length, and at the same time very broad, can be produced; but they are generally wanting in thickness.

2. *Ruby.*—To obtain the ruby, or red corundum, the same process is resorted to, merely adding a small quantity of fluoride of chromium to the fluoride of aluminium employed. There is, however, another

difference. Instead of a charcoal crucible, a crucible of alumina is used; and instead of a charcoal cupel for the boric acid, a platinum one is preferred The colour of the rubies thus obtained is identical with that of the natural specimens. The rosy-violet tint so much admired in the natural gem is present in the artificial one, where it is due to sesquioxide of chromium.

3. *Sapphire.*—The sapphire, or blue corundum, is produced under the same circumstances as the ruby. It is also coloured with chromic oxide, the only difference between them consisting in the proportion of the colouring substance. Perhaps, also, there is a slight difference in the degree of oxidation undergone by the chromium in the case of sapphire production. But in such cases analysis can teach nothing, as the quantities of colouring matter in either case is so extremely small. In some cases, the authors of the memoirs alluded to above have obtained, at the same time, crystals of ruby and crystals of sapphire, the former of a red colour, the second of a magnificent blue tint identical with that of the oriental sapphire.

4. *Green corundum.*—When the quantity of chromic oxide in these experiments is very considerable, the corundum obtained is of a brilliant green colour, similar to that of *Ouwarovite*, a mineral to which we have already alluded in the GEOLOGIST,* as containing 33·5 per cent. of oxide of chrome (according to Dr. Lewy and others) but which, from M. Damour's analysis, appears to contain only 25 per cent. This green corundum is always formed in that part of the crucible where the fluoride of aluminium and the fluoride of chromium are placed; the latter becoming relatively more and more concentrated as the operation proceeds (on account of its being the least volatile of the two compounds), explains how it is that this green variety of corundum is produced in this case in preference to the ruby or sapphire varieties.†

5. *Zircone.*—Is produced by the same process as corundum (except that fluoride of zirconium is employed in the place of fluoride of aluminum). The zircone, or oxide of zirconium, shows itself in the shape of minute crystals regularly grouped in arborizations not unlike those obtained sometimes with sal-ammoniac. The chemical properties of zircone thus obtained are the same as those of the natural specimens; but nothing is stated concerning the mineralogical or crystallographical characters.

6.—The authors proceed to state that they have also obtained, by the above method of experimentation, crystallized oxides of other metals, *e. g.* of uranium, titanium, and tin. But neither their crystalline forms nor their chemical composition have yet been investigated sufficiently to be spoken of with certainty.

7. *Cymophane* or *Chrysoberyl.*—This mineral is an aluminate of glucina, *i.e.* a compound of alumina and glucina. It is much prized by jewellers, as it is capable of taking a fine polish, and produces a magnificent gem when well cut. The French jewellers call it *Chrysolite orientale*, whereby it is often mistaken for yellow corundum, which goes under the same denomination. The colour varies from yellow to greenish

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* The GEOLOGIST, No. I., p 66.

† All the above varieties of corundum are met with in nature.—T. L. P.

yellow. It is found in the pegmatite-granites of North America, or as rolled crystals in the sands of the Brazils and Ceylon. According to Messrs. Deville and Caron, it can be artificially produced by the new method above described. Fluoride of aluminium and fluoride of glucinium are mixed in their equivalent proportion, and their vapours are decomposed by vapours of boric acid. The crystals of cymophane thus obtained are completely similar to the fine samples that come to us from America. They actually present the striæ and the peculiar heart-shaped make which are so characteristic in the natural mineral.

8. *Gahnite.*—Gahnite, a rare mineral (which must not be confounded with *garnet*), named after the illustrious Swedish mineralogist Gahn, professor and friend of the afterwards celebrated Berzelius, is an aluminate of zinc, which hitherto has only been found in Sweden, and perhaps also near the town of Franklin, in North America. To obtain this mineral artificially, Messrs. Deville and Caron made use of an iron crucible, into which they introduced a mixture of fluoride of aluminium and fluoride of zinc. The boric acid employed was placed in a platinum cupel, and the operation conducted as before described.

In this experiment gahnite is deposited on different parts of the apparatus, where it crystallises in well-defined and brilliant octahedrons. They are rather strongly coloured by iron-oxide, which they obtain in all probability from the iron crucible; otherwise, the crystals resemble the natural specimens, which, moreover, are mostly grey or of a greenish tint.

9. *Staurotide, &c.*—If in the foregoing experiments we put the vapour of a metallic fluoride (for instance, fluoride of aluminium) in contact with *silica*, by placing the latter in the little cupel instead of boric acid, we shall find that certain silicates may be obtained in a crystalline state. The authors, whose paper we have before us, have thus succeeded in obtaining a crystalline substance possessing the aspect of staurotide, of which it has also many of the physical and chemical properties.

The same substance is very easily obtained by heating alumina to a high temperature in a current of gaseous fluoride of silicium. In this operation the amorphous alumina is transformed into a mass of crystals which possess, at least, the composition of staurotide.

A silicate of zircone has been obtained in the same manner; but the authors have not completed their investigations of the last-named substances.

In the foregoing methods of experimentation, when fluoride of silicium is decomposed by oxides, the compounds that result from this decomposition can only contain a comparatively small amount of silica; it is therefore difficult, if not impossible, to obtain in this manner silicates which are known to contain a large proportion of silicic acid. Thus, for example, the authors endeavoured to obtain emerald by the action of fluoride of aluminium and fluoride of glucinium on silica. But the experiment failed.* A substance was obtained that crystallised in very hard hexagonal laminæ; but it was not emerald, for by analysis it was proved deficient in silica.

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* We have already shown in the pages of the GEOLOGIST, that according to the recent interesting experiments of Lewy and Daubrée, it is extremely probable that water has played an important part in the formation of this beautiful mineral species.—T. L. P.

It will be perceived from what has just been related, that fluoride of aluminium decomposes silica to form fluoride of silicium and staurotide. And, also, that in the same manner, fluoride of silicium in contact with alumina gives fluoride of aluminium and staurotide. This is the reason why our smelting crucibles and other metallurgical apparatus are often entirely transformed into a rough mass of crystals, almost all of which consist of the mineral species staurotide. The preceding observations explain also how volatile fluor-compounds in the presence of argillaceous substances may become the means of obtaining crystals of substances which are perfectly insoluble or infusible at the temperatures at which these fluor-compounds operate. This remarkable influence of metallic fluorides in the production of crystallized mineral species must have played a certain part in nature—more particularly in the production of crystallized minerals in lodes and veins. At least, such is the opinion of M. H. Deville; and M. Daubrée seems already to have arrived at this conclusion in his beautiful memoirs on the metallic fluorides. At the end of their paper, Messrs. Deville and Caron state that they have likewise artificially obtained rutile, or titanic acid, an interesting mineral species, in decomposing a fusible titanite by silica. Titanite of protoxide of tin was preferred for this experiment. During the operation, the authors remarked dissolved in the metallic tin, a brilliant substance, crystallised in wide metallic laminæ, easily separated from the tin by dissolving the latter in hyrochloric acid, and which turned out to be an alloy of iron and tin, containing equal proportions of each.

It was stated several months ago, that the immense work of a tunnel under the Alps between Modane and Bardonèche had commenced. We have now to record some interesting facts, which might perhaps never have been discovered but for the peculiar methods employed in this colossal operation. The crest of the mountain attains so great a height that the sinking of shafts, which is generally done in order to begin boring at several points at once, was in this case out of the question. Hence the tunnel could only be worked at its extremities, so that the labour by the ordinary process of working could not be accomplished in less than thirty-six years! Then, how was a depth of gallery of one or two miles, or more, and having but one orifice, to be aired? These were very serious obstacles.

MM. Elie de Beaumont and Angelo Sismonda having examined the mountain geologically between Modane and Bardonèche, found it composed of micaceous sandstones and schists, quartzite, gypsum, and limestone, all easy to blast, the quartzite alone excepted; but the stratum of this is not likely to be very thick. The other difficulties alone, therefore, remained, and these were at length overcome by three Sardinian engineers, MM. Sommeiller, Grattone, and Grandis, who proposed to turn the abundance of water, for which the locality is remarkable, to account by applying it to a peculiar system of perforation and ventilation, which we will now endeavour to explain. The first apparatus imagined by these gentlemen consists of an hydraulic air-condenser (*compresseur hydraulique*), which is nothing more than a syphon turned with its orifices upwards, and communicating by one of them with a stream of water, by the other with a reservoir of air. The water descending by the first branch enters the second, and, by the pressure it occasions, condenses the air, which is then forced into the reservoir. This done, a valve is opened by which the water contained in the syphon is let out, and the operation recommences. The emission and introduction valves are regulated by a small machine operating by means of a column of water; and the air in the reservoir is maintained at a constant degree of pressure by a column of water communicating with another reservoir above.

Thus with a waterfall twenty metres in height, the air is condensed to six atmospheres, equivalent to the pressure of sixty-two metres of water. This condensed air is used for two purposes—first, as a motive power; second, for ventilation. Two kinds of perforators * worked by condensed air instead of steam, are employed; and the manner in which these machines perform their duty affords the first practical demonstration of the possibility of employing compressed air as a motive power with advantage. By means of the perforators holes for blasting may be bored through the hardest syenite in one-twelfth of the time which would be required if ordinary means were employed. It may be stated here that in blasting rock three-fourths of the time are employed in boring holes, and the remainder in charging and blasting; hence, accelerating the former operation is a great advantage. Moreover, it is said, that by making use of the apparatus mentioned above, eighteen perforators may be set to work in a place where three couples of miners would hardly find room. So that by these ingenious contrivances, as well as by others for clearing away, &c., the perforation of the tunnel may be effected in six years instead of thirty-six.

The air that has been employed as a motive power is used to ventilate the gallery; but when the latter shall have reached a considerable depth, it will require 85,924 cubic metres of air every twenty-four hours to replace that which has been vitiated by respiration, torches, and gunpowder; and this quantity, in the form of 14,320 cubic metres condensed to six atmospheres, the reservoir can furnish. A curious phenomenon has been observed during these works:—When the air, condensed to the degree above-mentioned, is shot from the machine into the gallery, any water happening to be near the apparatus suddenly congeals, although the ambient temperature be about 18° (centigrade); an effect owing to the rapid dilatation of the air the moment it is expelled from the machine. Hence, when a large mass of compressed air is driven into a gallery situated at 1,600 metres below the outer surface of the earth—for such is the level of the Alpine tunnel—and where, consequently, the temperature must be about 50° (centigrade), the dilatation of the compressed air will produce a diminution of temperature sufficient to counterbalance the excess alluded to.

The progress now making per day in boring this tunnel is three metres on each side of the mountain, or six metres per day in all. The thickness of the Alps between Modane and Bardonèche is estimated at about thirteen kilometres, or rather more than two leagues and a half.*

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* One invented by Mr. Bartlett; the other by M. Sommeiller.

In a letter, writen at Luchon, to M. Cordier, member of the French Institute, M. Leymerie gives a description of an ascent of the Muladetta, and of the different kinds of granite he has observed in the Pyrenees and in the Haute-Garonne. The ascent, which lies entirely over granite, can now be made in two days, by following the route indicated in 1842 by M. de Franqueville. The summit of the Muladetta, called le Pic de Nethon (the highest summit of the Pyrenees, and, according to Reboul, attaining to 11,443 feet), which, from the portof Venasque, looks so acute, consists in reality of a small plateau, composed of accumulated blocks and fragments of rock very similar to the accumulated fragments observed at the summit of Mont Perdu.

The fundamental rock of the Muladetta is a small-grained granite, with white feldspar and nearly black mica, which M. Cordier has formerly described with great accuracy. But the summit of the Pic de Nethon offers a different kind of rock—a peculiar species, which may perhaps be classed between granite and quartziferous porphyry. In a quartzo-feldspathic cement of a dirty grey colour, the eye distinguishes, on the surface of this rock, bits of grey quartz, scarce lamellæ of mica, a few spots of amphibole and rectangular crystals of rose-coloured orthose (feldspar), which gives a rosy tint to the rock when viewed from a little distance. This last-named species of granite appears to predominate in the culminating parts of the mountain, and M. Leymerie supposes it to have penetrated through the former, which seems to have been uplifted in the solid state, together with the transition strata which overlie it.

The small-grained granite before alluded to must, therefore, have played a passive part in the formation of these high mountains, whilst the grey porphyroid variety has been the eruptive element.

It is not so, however, with the porphyroid granite, bearing large macled crystals of orthose, which forms the culminating portions of the Pyrenees from Maupas to Claribade, and which is very characteristic in the higher parts of the valley of Oo. This one, on the contrary, offers also unmistakeable eruptive characters.

After a minute investigation of these rocks, the author comes to the conclusion that there are three principal sorts of granite rocks in the Pyrenees and the Haute-Garonne.

1. The small-grained granite which might be termed, according to M. Leymérie, "granite Pyrénéen," from its abundance in the Pyrenees, and which must be considered, in an eruptive sense, as passive.

2. The porphyroid granite of the culminating points. And,

3. The various granitic or feldspar rocks of Luchon, and the lower parts of the valley.

The last two have played an active or eruptive part in the formation of the Pyrenees, and have produced veins, dislocations, unmistakeable phenomena of metamorphism, &c.

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* The principal facts in the above have been extracted from a paper lately addressed to the *Academy of Sciences* at Paris, by L. F. Ménabréa, entitled—*Note sur le Percement des Alpes entre Modane et Bardonèche,* which may be consulted by those of our readers who are desirous of further technical details.—T. L. P.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Greenwich Natural History Club.—On Saturday, August 21st, 1858, a Field-day Meeting of this club took place at Bexley, Kent, under the guidance and upon the invitation of Mr. Flaxman Spurrell. The chief object of the meeting was to examine the extensive excavations between Crayford and Erith, from which a large number of Mammalian remains have been obtained, many of them being in the possession of Mr. Spurrell, of Bexley, and Mr. Grantham, of Crayford. Besides the members of the club, invitations were sent to some of the leading naturalists and geologists. The unfavourable state of the weather prevented a large attendance of members, and although the meeting was not numerous, still it was very pleasant and instructive. The members and friends were kindly received and hospitably entertained by Mr. Spurrell, for, after viewing the extensive series of Mammalian bones and chalk fossils, collected and preserved with taste and care, they sat down to an elegant and substantial collation. Among the members present were J. F. South, Esq., Dr. Purvis, Dr. Bossey, Messrs. W. P. Lethbridge, H. T. Stainton, W. Groves, the Rev. J. H. Knox, &c. Much interest was excited by Mr. Spurrell's collection, which contains some fine specimens of *Echinodermata* from the chalk, and a large series of fossil-remains of the elephant, horse, ox, deer, rhinoceros, cave-lion, &c., obtained from the brick-earth deposits of Crayford and Erith.

The members also visited Mr. Grantham, at Crayford, who has for many years past taken considerable interest in the same ossiferous deposits, and has formed a valuable and interesting collection. Amongst these choice specimens was a fine example of the lower jaw and teeth of the *Elephas primigenius*, which Mr. Grantham has since most liberally presented to the Hunterian Museum, at the Royal College of Surgeons.

Mr. Grantham's collection had been previously visited by Dr. Falconer, who identified remains of the following species—*Elephas antiquus*, *Rhinoceros leptorhinus*, *Equus* (a large species), *Cervus* (*Strongyloceras ?*), *Bos*, and *Felis spelæa*, also *Elephas primigenius* and *Rhinoceros tichorhinus* ; the two latter are considered by some to belong to a newer period than that of the other animals.

The party subsequently visited the brick-earth pits where these remains have been found.

The brick-earth or old river-deposits of this locality repose on an abraded or excavated surface of the lower tertiary sands and chalk. They consist of loam, sands, and gravels. The bones above enumerated occur with a number of Testacea. Most of the species of the latter are still existing in the adjoining river; two only being found elsewhere, *Unio littoralis* of the south of Europe, and a *Cyrena*, said to be identical with a species now living in the Nile.

The interesting feature here to be noticed, namely, the occurrence of existing molluscs with remains of extinct mammals, has been already brought forward in Sir C Lyell's works, as evidence of the comparative tenacity of existence shown by molluscan species.

Among the rarer bones are those of the great Cave-Lion (*Felis spelæa*), which must have carried devastation amongst the herds of Herbivora, some of them of gigantic proportions, that pastured in the woods and wilds of this country, then probably not dissevered from Europe.

The association of the two species of Elephant, and the two of Rhinoceros is here to be remarked, inasmuch as the *E. antiquus* and the *R. leptorhinus* are regarded as of an older date than the other species of the same genera here associated together. It is earnestly recommended, therefore, that as far as possible, in collecting the bones and teeth from these deposits, attention should be given as to the actual place of the specimens in the several layers of loam, &c., so that those occurring in the upper part should not be indiscriminately mixed with those taken from a lower position. By this means a determination may be arrived at whether there be one, two, or more distinctly marked stages in the history of the life and death of these great creatures.—*J. Morris.*

MALVERN NATURAL HISTORY FIELD CLUB.—The last field day for the season of the Natural History Field Club was held in the Eldersfield district, the club meeting at Pendock, where they commenced their investigations with the examination of the church, the site of the Abbey that once stood near, and the old road which trends from Gloucester by Eldersfield, Pendock, the Longdon marshes, and Welland, to Worcester. The next point was the "blasted elm," a lightning-struck tree which rears its shivered limbs high over the farm-house occupied by Mr. Shipton, of the Hill, in the parish of Eldersfield; and thence the ramblers walked leisurely to the admirably restored church, a few years since a monument of God-forgetfulness, but now an evidence of the better spirit that has arisen in our land. After partaking of the hospitality of the vicar (the Rev. R. Holmes), the club visited the ancient camp of Gadbury, and discoursed on the British and Roman warriors who successively occupied that area, as well as on the denuded vales of the Lower marls and the steep anticlinals and synclinals of the Keuper Sandstone. The summit of Gadbury is a perfect plain, capped by Northern Drift—an evidence of the rapid currents which set in during the glacial epoch in this part of Worcestershire, and scouped out the deep valleys of the Lower Keuper Marls. From Gadbury camp the party crossed the Pendock Portway, one of the lines of ancient Roman roads which ran from the camp of Wall-hills, near Ledbury, to the farm of Mr. W. Fisher, in the parish of Pendock. Here they examined the Spanish and Portuguese gold coins found two years ago in a field hard by, and with them a number of silver pieces of the reigns of bluff King Hal and of good Queen Bess. Berrow-hill was then crossed, and the Lower Lias outlier examined. The restoration of Berrow church called forth universal acknowledgment of the good work done by Mr. Law and his parishioners. In the churchyard the party lingered over the tomb of the victims at "The Murder House," and afterwards passed the cottage where the fearful massacre was perpetrated. A substantial repast awaited them at the Duke of York, where the room was adorned with evergreens, in frames of which were hung twelve splendid pictorial illustrations of Irish geology, the property of Dr. Melville, Swiney Lecturer on Geology, and Professor of Natural History at Queen's College, Galway. After dinner, Dr. Melville delivered an eloquent address on the subject of the diagrams, which was followed by the President on the geology of the day's ramble. The day had been one of unchequered sunshine, and the party separated right sorry that their peregrinations had come to a close, and mutually wishing that next season they might meet again under auspices as bright and fair. Reynolds Peyton, Esq., of Barton Court, and the Rev. R. Pilson, of Birts-morton, were elected members, and the Rev. C. Clarke was proposed for the next ballot. Among the gentlemen who assembled were the President (Rev. W. S. Symonds), T. M. Lingwood, Esq., Lyston, Herefordshire, E. G. Stone, Esq., Dr. Melville, C. Gully, Esq., T. Sewell, Esq., and the Revds. Canon Davies, R. Holmes, R. Hill, R. Pilson, H. Stone, and C. Clarke.

NOTES AND QUERIES.

"SIR,—Would there not be some considerable advantage in bringing the works of the Palæontographical Society before the notice of your readers? Many persons, I am sure, are not aware of the existence of that excellent society, and would become subscribers if they knew the titles of the monographs now completed, and in progress. Many, too, would be willing to purchase particular volumes, if they were informed that they were at liberty to do so. I leave, however, the subject in your hands, and remain, your obedient servant, THOMAS WILTSHIRE Rectory Bread-street Hill."—We think a notice of the Palæontographical Society a legitimate object, and we shall shortly act upon the suggestion of our correspondent, as too much publicity cannot be given to the many excellent memoirs already published.

TO EXTRACT MOLLUSCOUS ANIMALS FROM THEIR SHELLS.—"The only trouble is with spiral shells, such as in Gasteropods. Slide them gently from a piece of paper into hot water, so as not to crack the shells; let them boil a few seconds, then take them out and draw them by the method described below. If the shells are rare, or thick, or delicate, you will eliminate the risk of crack or fracture thus: Put the shells into cold water, boil it, then take the vessel off the fire, and allow it to cool gradually, so as to anneal the substance of the shells, before you commence operations. To draw out the animal: Take half-a-dozen inches of the finest piano-forte wire, give it two or three helical turns round a cylinder—round a black-lead-pencil does as well as anything; you then have a corkscrew-looking instrument, and with a knife and file you can give it a few barbed notches toward the point. Thus armed, with a little tact and delicacy of grasp, acquired by practice, you gently introduce the spiral wire into the body of the shell, being careful not to send the point through it, and upon withdrawing the wire with a spiral motion, you will extract the animal impaled upon it most satisfactorily. If you find the wire slippery to hold, get a grip upon it with a small hand-vice, such as watchmakers use.—CHARLES MARTEL."

KENT NATURAL HISTORY SOCIETY.—"DEAR SIR—I see in the GEOLOGIST this month an account of a meeting of the East Kent Natural History Society. I do not know to whom you are indebted for that report, but as it contains several inaccuracies, and as your GEOLOGIST is largely circulated among our members, I take this opportunity of correcting them. Firstly, it is stated that the association has been in obscure existence some years; this society was only inaugurated in April last, and now numbers over 150 members. The meeting at Dover was not one of the annual meetings, but only one of four local meetings which have taken place this year. I enclose a prospectus of the society, and shall be happy to send you any reports of future meetings.—Yours faithfully, GEORGE DOWKER, Hon. Secretary, Stourmouth, Oct., 1858."—We regret the occurrence of the inaccuracies noticed, but we were lead into them both by the language of the communications we received and by the reports in the local newspapers. We know of the existence some years since of a Kent Natural History Society, the collection belonging to which was formerly at Maidstone, and part is still, we believe, in the Museum of that town, and part in the Museum at Dover. It is easily perceived how we were lead into the idea that it was a resuscitation of this society which had taken place. As a man of Kent, the Editor can but feel the warmest interest in this society, and will be obliged to the Secretary for the promised notices of its proceedings.

"DEAR SIR,—A short time since the tusk of an elephant was taken out of our cliff. It has mouldered away considerably since its discovery. Many bones and molar teeth of elephants have been taken out of our cliffs at different periods. There have been found, also, remains of Irish elk (*Cervus Megaceros*), and I have obtained a ear-bone of a whale, out of a large mound of gravel and sand, near Skipsea Brough. I am, dear Sir, &c, EDWARD TINDALE, Bridlington."

GEOLOGY OF SOUTH DEVON.—"SIR,—Can you inform me of any work on the geology of the district around Plymouth, South Devon, besides the Geological Report of Sir H. De la Beche on Devon and Cornwall?—Yours &c., E. S. A."

BRITISH ASSOCIATION MEETING.

(Professor Owen's *Address.—Continued from page* 450.)

Last year, M. Poitevin's production of plates of relief for the purpose of engraving by the action of light alone was cited as the latest marvel of photography. This year has witnessed photographic printing in carbon by M. Pretschi. M. Nièpce de St. Victor has succeeded in reproducing the colour of the original on metallic plates, though he cannot fix it; and these lovely "heliochromes" unfortunately vanish like the breath from a mirror. Mr. Scaife has obtained a portrait of a shell in full flight a few feet after it left the mortar, with a representation of phenomena in the development of the smoke too transitory for the eye to ascertain when they occur. Photography may hence superadd a new defining function to the highest attainable telescopic power.

The first application of the electro-magnetic discovery was, as it should be, to the direct service of the philosopher. The application of a delicate compass-needle would show by its delicate deflection the strength of the voltaic current. Out of this followed the knowledge of thermo-electricity. Faraday's demonstration—the converse of Oersted's—that magnetism could produce electricity, has been succeeded by other brilliant discoveries by that most exemplary investigator of natural laws. Out of Oersted's painfully-pursued experiments with his little magnets, voltaic pile, and bits of copper-wire has come the electric telegraph!

Bacon, commenting on the "History of the works of Nature," describes it as a chaos of "fables, antiquities, quotations, frivolous disputes, philology, ornaments, and table-talk." Since his day, the chief steps by which natural history has advanced to the dignity of a science are associated with the names of Ray, Linnæus, Jussieu, Buffon, and Cuvier. Now, not only has the structure of the animal been investigated even to the minute characteristics of each tissue, but the mode of formation of such constituents of organs, and of the organs themselves, has been pursued from the germ, bud, or egg, onward to maturity and decay. To the observation of outward characters is now added that of inward organization and developmental change, and zootomy, histology, and embryology combine their results in forming an adequate and lasting basis for the higher axioms and generalizations of zoology properly so-called.

The study of homologous parts in a single system of organs—the bones—has mainly led to the recognition of the plan or archetype of the highest primary group of animals, the vertebrata. The next step of importance will be to determine the homologous parts of the nervous system, of the muscular system, of the respiratory and vascular systems, and of the digestive, secretory, and generative organs in the same primary group or province. It is of more importance to settle the homologous of the parts of a group of animals than to speculate on such relations of parts in animals constructed on demonstratively distinct plans of organization. What has been effected and recommended in regard to homologous parts in the *Vertebrata* should be followed out in the *Articulata* and *Mollusca*:—

"The present state of homology in regard to the *Articulata* has sufficed to demonstrate that the segment of the crust is not a hollow expanded homologue of the segment of the endoskeleton of a vertebrate. There is as little homology between the parts and appendages of the segments of the vertebrate and articulate skeletons respectively. The parts called mandibles, maxillæ, arms, legs, wings, fins, in insects and crustaceans, are only 'analogous' to the parts so called in Vertebrates; and to express definitely the clear ideas now possessed of their essential distinction, will require a distinct nomenclature."

The investigations of the vitellus, of the entozoa, of the metamorphoses of insects, and the subjects investigated by means of the microscope, are next passed under review.

A very interesting application of the microscope to the examination of the particles of matter suspended in the atmosphere has been made. Cloudy extents of dust-like matter pervading the atmosphere, which have been variously observed, have been thus found to consist of the pollen of plants, vegetable species, and Diatomaceæ, and this investigation promises to be productive of other important results.

In micro-geology recent progress has been made:—

The microscopic organisms hitherto observed in the oldest fossiliferous deposits, Silurian greensands, for instance, are spicula of *Spongiæ*, siliceous *Polycystineæ*, and calcareous *Foraminifera.*

Ehrenberg has discovered that the substance of the greensands in stratified deposits, from the Silurian to the Tertiary periods inclusive, is composed of the casts of the interior of the microscopic shells of *Polycystineæ* and *Foraminifera.* The soundings which have been brought up from various parts of the Atlantic and the Gulf of Mexico, consist chiefly of similar microscopic polythalamous shells, mingled with a greensand composed of casts of *Foraminifera.* Thus the mode in which a deposit was made at the bottom of the great ocean of the Silurian period, is illustrated by that which the microscope has demonstrated to take place under similar conditions at the present day.

Perhaps the earliest indubitable evidence of diatoms has been obtained from the Eocene strata; and the forms here determined have been, for the most part, identified with existing species. Exotic species are not distinguishable from the British; difference of climate seems not to affect or relate to specific difference, and the same exemption from such influence through the minute size and ample structure of the Diatomaceæ, seems to have been the chief condition of their geological longevity as species.

The progress of our knowledge in the geographical distribution and relations of plants and of animals are reviewed at great length.

The sum of these relations rests on the assumption thateach species has been created, or come into being, but once in time and space; and that its present diffusion is the result of its own law of reproduction, under the diffusive or restrictive influences of external circumstances. These circumstances are chiefly temperature and moisture, dependent on the distance from the source of heat and the obliquity of the sun's rays, modified by altitude above the sea-level, or the degree of rarefaction of the atmosphere, and of the power of the surface to wastefully radiate heat. Both latitude and altitude are further modified by currents of air or ocean, which influence the distribution of the heat they have absorbed.

The modes of generalizing the observations on the geographical distribution of indigenous plants are various.

One is by dividing the horizontal range of vegetation into zones, bounded by annual isothermal lines, as 1, equatorial; 2, tropical; 3, subtropical; 4, warmer temperate; 5, cooler temperate; 6, subarctic; 7, arctic; 8, polar, zones: with temperatures progressively falling from an annual isotherm of 79°·3 Fahr. to one of 36°·5 for the month of July.

Another mode is the classification of plants according to the regions of altitude; as into those of,—1, Palms; 2, Tree-ferns; 3, Myrtles; 4, Ever-greens; 5, Deciduous trees; 6, Conifers; 7, Alpine shrubs; 8, Alpine herbs. But the corresponding altitudes in different countries have frequently different, though analogous or representative species. The presence or otherwise of snow on the mountain-tops also influences the character of the plants at corresponding altitudes.

A third, and perhaps more truly natural, mode of expressing the geographical distribution of plants, is by regions defined by the proportion of plant-species peculiar to them. When one half, at least, of the known species are peculiar to a certain space, it constitutes a "phytogeographic" region, according to Schouw. In it, also, a fourth part of the genera must be either peculiar, or so predominating as to be comparatively rare in other regions; and the individual families of plants must be either peculiar to, or decidedly predominate in such region.

So defined, the surface of the earth has been divided into twenty-five regions, of which I may cite as examples that of New Zealand, in which Ferns predominate, together with generic forms, half of which are European, and the rest approximating to Australian, South African, and Antarctic forms; and that of Australia, characterised by its *Eucalypti* and *Epacrides*, chiefly known to us by the researches of the great botanist, Robert Brown, the founder of the "Geography of Plants."

Organic Life, in its animal form, is much more developed, and more variously, in the sea than in its vegetable form.

Certain horizontal areas, or provinces, have been characterized by the entire assemblage of animals and plants constituting their population, of which a considerable proportion is peculiar to each province, and the majority of each species have their areas of maximum development within it.

Of the provinces of Marine Life, that much lamented, far-seeing, and genial philosopher, Edward Forbes, has provisionally defined 25.

The same physical conditions are associated with a certain similarity between the animals of different provinces. Where those provinces are proximate, such likeness is due to the identity or close affinity of the species; but where the provinces are remote the resemblance is one of analogy, and species of different genera or families represent each other.

A second mode of expressing the ascertained facts of the geographical distribution of marine animals is by tracts called "Homoiozoic Belts," bounded by climatal lines; which are not, however, parallel with lines of latitude, but undulate in subordination to climatal influences of warm or cold oceanic currents, relations of land to water, &c. Of these belts nine are defined; one equatorial, with four to the north and four to the south, which are mutually representative.

But the most interesting form of expression of the distribution of marine life is that which parallels the perpendicular distribution of plants, according to the depth at which they live, in a manner very analogous to the changes in the forms and species of vegetation observed in the ascent of a tropical mountain. Edward Forbes has expressed these facts by defining five bathymetrical zones, or belts of depth, which he calls,—1, Littoral; 2, Circumlittoral; 3, Median; 4, Infra-median; 5, Abyssal.

The life-forms of these zones vary, of course, according to the nature of the sea-bottom; and are modified by those primitive or creative laws that have caused representative species in distant localities under like physical conditions,—species related by analogy.

Our space will not permit our proceeding step by step through this portion of the Professor's address, at any rate in this number, but the reference to the bearing of the ancient relations in geological eras of land and sea in the consideration of the question whether, and how many, distinct creations of plants and animals have taken place? is too important a topic to be omitted. The discovery of two portions of the globe, of which the respective faunæ and floræ are different, by no means affords the requisite basis for concluding as to distinct acts of creation. Such conclusion, unconsciously associated with the idea of the historical date of creative acts, pre-supposes that the portion of the globe so investigated by the botanist and zoologist has been a separate creation—that its geographical limits are still in the main what they were when the creative fiat went forth. But geology has demonstrated that such is by no means the case; the incalculable vistas of time past into which this science has thrown light are shown to have been periods during which the relative positions of land and sea have been ever changing; and already the directions, and, to an extent, the forms of the submerged tracts that once joined what are now islands to the primeval continents, are beginning to be laid down on geological maps.

These phenomena shake our confidence in the conclusion that the Apteryx of New Zealand and the Red-grouse of England were distinct creations in and for those islands respectively. Always, also, it may be well to bear in mind that by the word "creation," the zoologist means "a process he knows not what." Science has not ascertained the secondary causes that operated when the "earth brought forth grass and herb yielding seed after its kind," and when "the waters brought forth abundantly the moving creature that hath life." And supposing both the fact and the whole process of the so-called "spontaneous generation" of a fruit-bearing tree, or of a fish, were scientifically demonstrated, we should still retain as strongly the idea, which is the chief of the "mode" or "group of ideas" we call "creation," viz., that the process was ordained by and had originated from an all-wise and powerful First Cause of all things.

Remarks on Sanitary Science, Agriculture, the Water-supply and Drainage of

Towns, the labours of the Committee for obtaining the Uniformity of Weights and Measures, with remarks on the services of science to the State, conclude this luminous review of physical science in its ever memorable progress during the past two centuries.

British Association.—The papers read by the Rev. W. Norwood, Dr. Bevan, and the Rev. F. F. Statham have been forwarded to us for publication in this Magazine, and will appear in our pages. Sir R. I. Murchison has also very kindly caused an abstract of his paper to be forwarded to us; and we have to acknowledge similar courtesies from the Rev. E. Trollope, Mr. Page, Mr. S. Baines, and Mr. J. Yates; and more are promised from other gentlemen who attended the meeting.

Geology of Scotland.—Meeting of the British Association, 1858, (Continued).—Sir Roderick I. Murchison, the Director-General of the Geological Survey, laid before the Geological Section "The results of his researches among the Older Rocks of the Scottish Highlands." He commenced his observations by indicating the various steps which had been made in developing the geological structure of Scotland, from the days of Hutton and Playfair through those of Jameson and M'Culloch, to the state in which the subject was advanced a few years ago by the proofs of the existence of considerable numbers of organic remains of Silurian age in the southern Scottish counties, which, from the wild and hilly outline of most of them, have been termed the "Southern Highlands." This was the first great step made in the reform of Scottish classification; and for proofs of this, he referred chiefly to a memoir by Professor J. Nicol, in the "Journal of the Geological Society," and to his own memoir "On Ayrshire and the adjoining Counties." He then went on with a sketch of the knowledge progressively acquired respecting the structure of the North Highlands, pointing out that, besides what might be termed a lithological and mineral description of the oldest rocks, little or nothing had been effected in determining their true relative order of superposition—still less the identification of their different members by the evidence of fossil organic remains. For example, red conglomerates of different tracts, now known to be of various ages, had formerly been merged with the "Old Red Sandstone."

Passing over the presence of masses of Oolitic or Jurassic age (Brora, &c.), which he had formerly described in a memoir published in the "Transactions of the Geological Society," he showed to what extent Professor Sedgwick and himself had, thirty-one years ago, ascertained an ascending order from gneiss, covered by quartz-rocks with limestone, into overlying quartzose, micaceous, and other crystalline rocks, some of which have a gneissose character. They had also observed what they supposed to be an associated formation of red grit and sandstone; but the exact relations of this last to the crystalline rocks was not ascertained, owing to bad weather. In the meantime they, as well as all subsequent geologists, had erred in believing that the great and lofty masses of purple and red conglomerate of the western coast were of the same age as those on the east, and therefore "Old Red Sandstone." In addition to the valuable researches of Mr. Cunningham, the observations which the author made in the summer of 1855, when accompanied by Professor James Nicol, were communicated to the Geological Section at their last meeting at Glasgow; and to the abstract of that memoir, as published in the volume of the "Transactions," he referred, to indicate the then state of knowledge, and to prove the existence of a lower gneiss, clearly superposed by a younger series of crystalline rocks, as seen in sections from N.W. to S.E. across Sutherland, Caithness, Ross, Inverness, &c. The great feature, independent of the order of superposition, which has given to some of these lower rocks their most distinctive character, is the discovery by Mr. C. Peach, in the crystalline limestone subordinate to the quartz-rocks, of certain organic remains, which even at the Glasgow meeting he had affirmed (on the authority of Mr. Salter) to be of Lower Silurian age. He was indeed convinced, from the physical position of the masses alone, and their inferiority to the great and diversified series of Old Red or Devonian age of the east coast, that such was the epoch of their accumulation. Now, although he had also observed, in company with Mr. Nicol, the clear interposition of a great mass of coarse red conglomeratic grit between the older gneiss (see memoir in Trans. of British Association) and the quartz rocks, the extent of this interpolation had not been traced; nor, again, owing to very stormy weather, had he been able to satisfy himself that this red conglomerate was, or was not, conformable to the overlying quartzites and limestones. Aware that his friend Colonel James, R.E., was about to visit Sutherland, Sir Roderick requested him to determine the point, and this was clearly and satisfactorily accomplished by Colonel James, who traced over a considerable area a discordance between the red and purple sandstones of the north-west coast and the overlying crystalline rocks. Later in the same summer, Professor Nicol, revisiting Sutherland, extended similar physical phenomena from Cape Wrath down all the west coast of Lochalsh in Ross-shire, and published his results in the "Quarterly Journal of the Geological Society." So far, then, as the physical order was concerned, *i.e.* from the fundamental or older gneiss up through great mountains of purple and red conglomerate unconformable to the rocks both below and above, and a series of quartz rocks with limestones, covered by younger gneiss, no doubt remained. But Professor Nicol, doubting the value of the parallel the author had endeavoured to establish between the few and imperfect fossils of these lower limestones and those of Lower Silurian age, suggested that the quartzites and limestones might be the equivalent of the carboniferous system of the South of Scotland. Wholly dissenting from that hypothesis, Sir Roderick urged Mr. Peach to avail himself of his first leisure moments to re-examine the fossil beds of Durness and Assynt, and the result was the discovery of so many forms of undoubted Lower Silurian characters (determined by Mr. Salter), that the question has been completely set at rest—there being now no less than nineteen or twenty species of Maclurea, Murchisonia, Ophileta, and Orthoceras, with an Orthis, &c., of which ten or eleven occur in the Lower Silurian rocks of North America.

Having re-visited the region this summer, accompanied by Mr. Peach, and enjoying good weather, Sir Roderick was enabled to observe at many points the grand succession of rocks above indicated, and to confirm the view which he had laid before the Geological Society, of these true Lower Silurian rocks being surmounted by micaceous schists and flagstones often passing into a younger gneiss. But whilst the author is convinced that most of the crystalline and subcrystalline masses occupying the central and eastern parts of Sutherland and Ross are of younger age than the fossiliferous rocks of the North-Western Highlands, he admits that there may be tracts in that vast extent of country where the older or fundamental gneiss may be brought to light.

The ascending order, however, on the west coast of the Highlands—*i.e.* from a fundamental gneiss, through great unconformable purple sandstones up into siliceous rocks and limestones with Lower Silurian fossils—is in perfect harmony with the general order in North America, worked out by Logan in Canada and by geologists of the United States, and confirmed at the recent visit of Professor Ramsay; for in that quarter of the world there exists a wide spread of ancient gneiss, which is termed Laurentian, surmounted by a series of stratified coarse rocks, termed Huronian; and the last again is followed by sandstones and limestones, some of which, classed as Lower Silurian both by Logan in Canada and Hall in New York, contain the same fossils as the rocks of Sutherland. The intercalated purple and red sandstones (No. 2 of the Highland series) therefore clearly represent the Cambrian rocks, and are separated from the Old Red of the east coast by the whole series of the quartz rocks, limestones, micaceous and quartzose schists, all of which have afforded the materials out of which the true Old Red series has been formed.

The second part of the communication related to the Old Red Sandstone, properly so defined, as exhibited on the east coast, between the Orkney and Shetland Islands on the north, and Banffshire and Morayshire on the south, various points of which the author visited last summer. In Caithness and the Orkney Islands, accompanied by Mr. Peach, the author made various interesting additions to his former knowledge, particularly as derived from the researches of Mr. Robert Dick of Thurso. His belief was sustained that the ichthyolitic flagstones of

Caithness and the Orkneys, with their numerous fossil fishes, constitute the *central* member of the Old Red series, the lower part of which is made up of powerful conglomerates and a very great thickness of thin-bedded red sandstone, the whole resting on the crystalline rocks; whilst the central flagstones are surmounted by other sandstones, rarely red, and usually of yellow colour, which occupy the promontories of Holy Head, Dunnet Head, &c. In quitting this part of his subject, Sir Roderick passed a warm eulogium on his countryman, Hugh Miller (both natives of the same tract), and stated that he had specially visited Cromarty to see the progress which was made in erecting a monument to his eminent and lamented friend; and he had the gratification to announce, that when the British Association met next year at Aberdeen, the work would be completed; the only point on which he earnestly insisted being, that the column, which is to stand on a green knoll behind the house in which Miller was born, should be one of true "Old Red Sandstone." In Morayshire Sir Roderick made transverse sections, in company with the Rev. G. Gordon, of Birnie, from the edge of the crystalline rocks (there micaceous flagstone, in part used as slates) to the maritime promontories of Burg Head and Lossie Mouth, and was convinced that the yellow sandstones in which the air-breathing reptile, Telerpeton Elginense, was found, are truly part and parcel of the Old Red or Devonian series. In exploring the coast range from Burg Head to Lossie Mouth, he observed that the strata had been thrown up on an anticlinal, trending parallel to the more inland ridge with the Telerpeton; and that, whilst the inland ridges are associated with hard subcrystalline cornstones (limestones), first described by Professor Sedgwick and himself as analogous to the Old Red of England, so the coast-ridge, folding over, dips on the sea-shore beneath another band of similar cornstone, which in its turn is overlaid by flag-like, deep red sandstone, clearly seen in reefs at low water. In this Morayshire series there is not a trace of a carboniferous plant, and the strata are so bound together by mineral characters and fossil remains that they must all be grouped as Old Red or Devonian. Where fossil plants have been found in strata of this series, as in Caithness, and where the formation puts on a very different mineral aspect, the plants, which have been described by Hugh Miller and Salter, are distinct from those of the coal-period.

The chief additional data which had been gained by Sir Roderick during his last visit were owing to the discovery by Mr. Martin, of Elgin, of a large bone in the very beds at Lossie Mouth which had formerly afforded the huge scales of the supposed fish, called Staganolepis by Agassiz. On visiting these quarries with Mr. G. Gordon, he was so fortunate as to discover other portions of this large animal; so that comparative anatomists may now determine whether it belongs to fishes or reptiles. However this point may be decided, the existence of reptiles during the formation of this deposit is established beyond a doubt; since many slabs have been found in the coast quarries of Cummingstone and Covesea Hill, belonging to Mr. Alexander Young, in which are the footprints of both large and small animals, each footprint having the impression of three or four claws to it. A specimen, from Captain Brickenden, is in the Geological Society's Museum, and others have been sent to the Museum of Practical Geology, London; some of them having been contributed by Mr. Patrick Duff, of Elgin. The presence of large reptiles, as well as of the little Telerpeton, in this upper member of the Old Red Sandstone is therefore established.

After noting certain fossil fishes which occur in parts of the Duke of Richmond's estates in Banffshire, the author proceeded to review the great masses of sedimentary deposit lying along the eastern and southern faces of the crystalline rocks of the Grampians, which have been hitherto all classed as pertaining to the Old Red Sandstone, though he does not pretend as yet to be competent to describe their detailed relations. On these points, however, which Mr. D. Page is working out with ability, he begs to offer the following suggestion. The true base of the Old Red Sandstone, properly so called, is seen in Shropshire and Herefordshire to be a red rock, containing Cephalaspis and Pteraspis, which gradually passes down into the grey Ludlow rock; and in both of these contiguous and united strata, remains of large Pterygoti, but of different species in the two bands, are found.

Now, although the Arbroath paving-stone, and the grey rocks ranging to the north of Dundee, much resemble the uppermost Ludlow rock, they contain the Cephalaspis Lyellii, and if, therefore, classed with the Devonian rocks, they must, under every circumstance, be viewed as the very base of that natural group. It follows, therefore, that certain conglomerates on the flanks of the Grampians, which underlie all those grey rocks with Pterygoti and Cephalaspis, can no longer be united as they have been with the Old Red or Devonian, but must represent some portion of the Silurian system. In speaking of the lowest member of the Old Red Sandstone, as characterised by the Cephalaspis Lyellii, the author expressed his conviction, that in the north-eastern Highlands and Caithness the zone is represented by the vast thickness of thin-bedded red sandstone and conglomerates, which had been already adverted to as lying beneath the Caithness flags.

The author, who had recently visited Dura Den, in Fifeshire, in the company of Lord Kinnaird and the Rev Dr. John Anderson, whose work on that beautiful tract is well known to geologists, declared that there could be no doubt whatever that the yellow sandstones of Fife pertain truly to the Old Red group, are entirely subjacent to the lowest carboniferous sandstones, and are of the same age as the upper yellow sandstones of Elgin. A drawing, prepared by Lady Kinnaird (the splendid specimen being in the museum at Rossie Priory), of the fossil fish Holoptychius nobilissimus, nearly three feet in length, which was found on the occasion of this visit on the property of Mrs. Dalgliesh, was exhibited ; and as this species abounds in the lower and red portions of the deposit, and also occurs in the overlying yellow sandstones, associated with Holoptychius Andersoni and H. Flemingii of the latter, the age of the deposit is clearly substantiated. In conclusion, Sir Roderick said that this communication must only be considered as a rehearsal of what was to be done with more effect next year at Aberdeen, when further observations might lead him either to confirm or modify some portion of his views. In the meantime, the great fundamental reform of the North Scottish series, proving the ascent from rocks on the west coast, which are unquestionably older than any in England and Wales, to the much younger "Old Red Sandstone" of the east coast, is firmly established.

The communication was illustrated by several geological maps, including an old one coloured by himself 31 years ago, the maps of M'Culloch, Nicol, and Knipe, and a map of Sutherland which the author coloured this summer. Besides large diagrams, there were sketches of the west coast of Sutherland by Miss Charlotte Dempster.

Mr. Page also communicated a paper on Scottish Geology, under the title of "The Relations of the Metamorphic and Older Palæozoic Rocks of Scotland."

Under the same head, Dr. Anderson made a communication "On the Fossils and Yellow Sandstones of Dura Den." This interesting paper led to considerable discussion, of which we can only give a very abridged account.

Dr. Anderson said—"I shall only say a very few things, and that as briefly as possible. Sir Roderick Murchison began his lucid and elaborate statement by a reference to Cape Wrath, where, after a day of geological toil, he slept, I doubt not, soundly, in what Maculloch describes 'as the land's end of Scotland's wildest region, the advanced post of Scotland's wildest seas.' I shall now conduct you to the quiet scenes of the south, where, in the terms of classic mythology, the vale of Ceres, lately covered with the golden fruitage of autumn, terminated the fossiliferous deposit he was now to describe. I am relieved, however, of much of my task respecting *the position* of this deposit in the series, in consequence of what had been stated by Sir Roderick, who declares it now, as he did when he formerly visited the spot, to be a member of the true Old Red Sandstone, and to have no geological connection with the Carboniferous system above ; and I am happy also to say that I have no opponent upon this point seriously now to contend against, nor to be confronted by any Professor Nicol called upon to unlearn the lessons which I myself had taught him. Much error, however, still prevails regarding the Yellow Sandstone, both as to its true mineralogical characters and its geognostic relations. In Ireland, it seems to be utterly misunderstood by Sir Richard Griffith, who, in his communication to this section last year at Dublin, described the deposit as Carboniferous; while Mr. Jukes had gone so far on the wrong side as to declare his conviction that 'the whole of the fish-beds of Scotland, and the similar rocks in Glamorganshire and South Wales, might belong to the Carboniferous system.' This confusion arose, he believed, from the confusion in the rocks themselves, where, through means of the intrusive traps, they are all greatly upheaved and disturbed in their positions and their relations to each other. But in Dura Den the whole series are in the closest juxtaposition, and can be read off with the ease of letter-press for sectional descriptions. I will only further add, upon the question of age and position, that no *Pterichthys* has ever been found in any of the series immediately above the yellow deposit of Dura Den, and will challenge the detection of one from any of the '*Cephalaspis*,' or the grey sandstone beds beneath either in Forfarshire or in Caithness." Passing from this point, now, he thought, completely established, the doctor proceeded to a description of the fossils so abundant in the deposit. He said—"they had now obtained about four new genera and seven or eight new species of fish and crustacea. The beautiful drawing of the large specimen before them was that of *Holoptychius nobilissimus*, adding thus a new member to the Dura Den family of the genus, and placing it higher in the series than the rocks of Clashbennie, or those of Cromarty and Elgin in the north. He held in his hand a specimen of the two bones of the head, which he had just been informed by Sir Philip Egerton, now present, were termed the *glosso-hyal* plates that supported the lower jaw, and resembled very much the plates in the existing *Sudis gigas* of the American rivers. The huge Megalichthys of our Scottish coal-fields had, he was informed by the same high authority, three of the *glosso-hyal* supporters, as if Nature in her arrangements had made size a condition of organic structure. The whole organisms in the Dura Den deposit were in general very entire, of a deep pink enamelled colour, and when lying in their stony bed suggested the idea that, instead of the long series of geological terms to be counted, they were the creations of yesterday the relics of living things that had just ceased to breathe. His eye, while speaking, glanced at the large section in the opposite wall, in which he observed the *Dipterus* and *Diplopterus* family marked, in the accompanying description, as confined to the Middle series of the Old Red. Now he begged to inform the section and members around him that the specimens of both these genera, now in his cabinet at Newburgh, were both found in the yellow deposit or upper series of the formation. Upon the whole, he concluded there was in Dura Den a classic field for geologists of the deepest interest; much has been obtained, much remains to be detected in future researches."

The Alluvial Lands and Submarine Forests of Lincolnshire.—By the Rev. Edward Trollope, F S.A., General Secretary to the Associated Midland Architectural and Archæological Societies. — A great contest between the sea and the land had been raging upon the Lincolnshire coast for centuries before the arrival of the Romans in that part of Britain, whilst a similar conflict had also been very obstinately carried on between portions of the soil of that country and the fresh waters flowing from the interior of England at the same early period with varying success and attended by more or less permanent consequences. Traces of the sea's former conquests may still be observed at inland spots now removed twenty miles from its present boundary, and yet remains of forests are occasionally revealed sixteen feet below its usual level, and at some distance from the existing coastal line, equally indicative of losses sustained by the land. Above the wavy subsoil of Oxford clay, once forming the surface, has swept a violent rush of waters charged with boulders, large flints, remains of elephants and other pachydermata, silt, and gravel, in wild and eccentric profusion, and over these for the most part, has been deposited a funeral pall of peaty earth covering innumerable trunks of oaks, fir, alder, hazel, and other trees accompanied by their berries, nuts, and leaves. To prevent such aggressions on the part of the sea the Romans, entering into an alliance with the land, surrounded the Lincolnshire coast with a vast sea-bank pierced at intervals, and with due precautions, for the purpose of allowing an exit for the fresh water; at the same time they formed an immense catch-water drain reaching from the Nen to the Witham, with a view to the protection of the low lands from the injuries they were subject to from the fresh water flowing from higher levels towards the Wash. But besides the former forests of the fen-lands *within* the boundary of the Roman sea-bank, large tracts of similar lands, covered also with the roots and trunks of trees, are not unfrequently revealed at very low tides along the Lincolnshire coast *without* its ancient marine barrier. The question that arises most naturally as to how these became submerged, will now demand our consideration.

This fact has always been looked upon as a great mystery by the few scientific men who have turned their attention towards it, and various theories have been advanced for the purpose of solving the difficulty it presents to us. Some have thought that it has been caused by a change in the coastal line, some by the agency of earthquakes, and others by the subsidence of the land; whilst the fen-lands of the interior have generally been considered to have been formed through the neglect of the Saxons, in paying no attention to the system of artificial drainage introduced by the Romans, which occasioned floods to arise of a permanent character, the results of which are still so plainly evident. This last theory, however, is utterly untenable, as portions, at least, of the Roman sea-bank have been raised upon that very peaty stratum filled with roots of trees, which we are anxious to account for, and therefore it must have been formed *before* the Roman occupation of this part of Lincolnshire. Finding that the submersion of these forest-lands was not caused by the interference of art with nature, and that they extend beyond the sea-bank, and far below the usual level of the sea, the next theory that has been brought forward is, that they owe their origin to a change in the coastal line through the action of the sea.

Doubtless great changes have taken place in the form of the Lincolnshire coast, and many large estuaries are now completely filled up which are known to have formerly existed there, whilst from the remains of forest-produce beyond its present sea coast, it is clear that the land once extended far more to the east than it does now, but we can scarcely suppose, as has been suggested, that a higher ridge of land once existed beyond the present tidal line, serving to protect a plain lying below the sea level, of which the tree-covered islets, still occasionally visible, are a portion. The next theory, however, with regard to the phenomenon we are treating of, I believe to be the true one, and that is, that the large portions of the lowlands of Lincolnshire have sunk below their original level. Sub-marine forests are by no means uncommon; in Yorkshire several instances may be brought forward, such as that at Outhorne and other points on the Holderness coast. In Hartlepool Bay the remains of a similar forest occasionally excites much attention when revealed during the lowest neap tides, amongst which are found horns and bones of the ox and red deer, and even the wing-cases of land-beetles. The south coast possesses many examples of the same character, such as the tract between St. Michael's Mount and Newlyn, the former of which, according to Carew, was termed in old days "the rock in the *wood*," and another instance was lately revealed by the shifting of the sand in Padstow harbour, whilst a similar phenomenon attracted the attention of Giraldus de Parri, or Cambrensis, as long ago as 1188 on the shores of South Wales. Most of the examples of these submarine forests, if not all, that have come under my notice can only be accounted for, in my opinion, by the subsidence of the land. This theory may appear more marvellous, and therefore less likely to be true than the preceding ones, but when we find from the study of geology that certain strata, the undoubted deposit of water, are now upheaved far above the reach of that element, and that large tracts of land have sunk beneath it, we can only regard such changes as one of the usual, but always wonderful operations of nature. Strabo was well acquainted with this motive power in the earth's crust, as well as are our leading modern geologists, but as it may be supposed by some that such motive powers are now no longer exercised, it will be well to mention an instance of the subsidence and elevation of land during the historic period. I will allude, therefore, to that noted example afforded by the district about Pozznoli, in the Bay of Baiæ, and especially made manifest by the pillars of the Temple of Jupiter Serapis at that spot, and certified by documentary evidence. Originally that temple was, no doubt, built above the level of the sea, its site then sank twelve feet, so as to submerge its columns in a fresh-water deposit, which protected them from future injury. The subsidence, however, continued, and there the sea swept over newly-formed marshy surface, covering the columns of Jupiter's Temple to a depth of nine feet more, and exposing them to the depredations of that destructive bivalve, the "Lithodomus" of Cuvier, from which they have greatly suffered. At one period, then, they were sunk twenty-one feet below the sea level, leaving a little less than half their original height above it; but then another change took place, and the flat shore where this temple stands gradually rose again, a document of the reign of Ferdinand and Isabella of Spain, referring to a grant of land at Pozznoli made to the University of that town, "where the sea is drying up," and another of Ferdinand's alone a little later, speaking of the same locale, as one "where the ground was dried up." Again, an earthquake that occurred in 1819 on the delta of the Indus, was followed by very extraordinary and permanent changes in the levels of the adjacent districts, the eastern channel of that river bounding the province of Cutch suddenly deepening at Luckput from one to eighteen feet, and at the same time creating a large inland lake, whilst Sindree, above Luckput, together with its fort, gradually sunk below the newly created waters until its angle towers alone appeared above their surface; but in exchange for this depression, an elevation fifty miles long appeared rising from a previously flat plain at a distance of about five miles from Sindre, which the inhabitants very appropriately termed "Ullah Bund," or Mound of God.

Perhaps, however, the most striking modern illustration of what has once taken place in many portions of England, may at this time be witnessed in the United States. In 1811 the valley reaching from the mouth of the Ohio to that of the St. Francis, 300 miles long, was much convulsed, after which several new lakes were formed; the largest of these is one near New Madrid, in Missouri, and termed "the sunk country," from whose placid surface rise the trunks of innumerable semi-submerged trees, all dead, and whitening in the wind previous to the final plunge they must all shortly make into that deadly element below, wherein so many of their brothers have already sunk before them. It may be remarked, however, that volcanic agency was the cause of the first subsidences spoken of, whereas no signs of such a power exist in the lowlands of Lincolnshire or on its coast. But neither are they to be found in that of the American sunk country; nor do earthquakes usually leave any direct evidences of their mighty agency behind them, although they often have been connected with permanent changes of the earth's surface of a great and extraordinary character. Again, even some natives of Lincolnshire may say, "But when had we earthquakes?" I will therefore instance a few. In 1048 there was a serious convulsion in that county; also another in 1117 that particularly affected the division of Holland, greatly endangering and injuring Croyland Abbey, portions of which, then just built, were with difficulty stayed up by vast timber props. In 1185 Lincoln was much damaged by an earthquake. In 1448 a violent shock was again felt in the southern parts of the country. In 1750 a shock was felt throughout its whole extent, and another in the Bourn district so late as the year 1792. It is not necessary to point to any instances of elevation of land in Lincolnshire as a counterpoise to the subsidence of others, for the purpose of corroborating this theory, which I have ventured to advance, because none was observable in the case of the Missisippi Valley and other examples; but I am inclined to think that a slow upward movement has began to take place in large districts of Lincolnshire long ago, and that by means of carefully-conducted scientific observations, this will hereafter be certainly proved and accurately measured. The filling up of channels and estuaries of large size that formerly existed, and the very rapid growth of its coast, apparently indicate this, whilst the known gradual but continually increasing elevation of the Danish coast and parts of Norway, greatly strengthen such a supposition. Nor need such a hypothesis be considered extravagant; there stands the fact of the existence of submarine forests. They must have acquired their present position through some convulsion of nature;

that I believe to be subsidence, and surely the unheaval of lands is not more extraordinary than their depression; at all events, both phenomena *have* repeatedly occurred on a very large scale, and in conclusion I thankfully shelter my opinion behind the strong shield of Sir Charles Lyell, who says in his "Principles of Geology," p. 289, "If we could compare with equal accuracy the ancient and actual state of all the islands and continents, we should probably discover that millions of our race are now supported by lands situated where deep seas prevailed in earlier ages. In many districts not yet occupied by man, land, animals, and forests now abound, where ships once sailed; and on the other hand, we shall find on inquiry that inroads of the ocean have been no less considerable. When to these revolutions produced by aqueous causes, we add analogous changes wrought by igneous agency, we shall perhaps acknowledge the justice of the conclusion of Aristotle, who declared (Meteorics, chap. 12) that 'the whole land and sea on our globe periodically changed places.'"

In the Geological Section, under the presidency of Wm. Hopkins, M.A., F.R.S., the following papers were read:—

T. W. Embleton.—On the Northern Division of the Yorkshire Coal Field.
Rev. J. W. Norwood.—On the Comparative Geology of Hotham, near Cave.
J. W. Dawson.—On Vegetable Structure visible in the Coal of Nova Scotia.
G. Bevan, M.D.—On the Marine Shell Bed of the South Wales Coal Basin.
Rev. E. Trollope.—On the Geology of a part of Lincolnshire hitherto unexplained.
Rev. F. F. Statham.—On the Geology of the Scilly Islands.
Sorby, H. C.—On the effect of currents in producing the structure of the Millstone Grit.
T. P. Teale.—On the Deposits of the Aire Valley.
J. G. Marshall.—On the Geology of the Lake District.
W. Pengelly.—On a recently discovered Ossiferous Cavern, at Brixham, Devon; and On the progress made in the excavation at the Brixham Bone Cave, by Professor Ramsay.
Professor Phillips.—On the Hematite Ores of North Lancashire, and a communication from R. Baker, Jun., on the Hematite deposits of West Cumberland.
Professor Harkness.—On the Origin of Breccias of the Southern portion of the valley of the Nith.
Albany Hancock.—Remarks on certain vermiform fossils found in the Mountain Limestone Districts of the North of England.
W. Pengelly.—On an Ichthyolite found in the Devonian Slates of East Cornwall.
———— —On the Trilobite found at the Knoll Hill, Newton Abbott, Devon.
David Page.—On the Skeleton of a Seal from the Pleistocene Clays of Stratheden, Fifeshire.
Professor Phillips.—Notice of some phenomena at the junction of the granitic and schistose rocks in West Cumberland, and on the slaty cleavage in the Lake District.
Professor Harkness—On the distortion of Fossils.
Professor King.—On the jointed structure of Rocks, particularly as displayed in some localities in Ireland.
H. C. Sorby.—On some peculiarities in the arrangement of the minerals in igneous Rocks, and on a new method of determining the temperature and pressure at which various minerals and rocks were found.
David Page.—Further contributions to the palæontology of the "Tile-stones," or Siluro-Devonian strata of Scotland.
Professor Huxley.—Observations on the genus Pteraspis.
Charles Moore.—On the conglomerates near Frome, and their organic remains.
Edward Charlesworth.—On some remarkable Yorkshire Fossils, including the unique Plesiosauri in the Museum at York, with pictorial restorations, by Mr. Waterhouse Hawkins, of the Crystal Palace.
Rev. Wm. Thorpe—On the Permian System in Yorkshire.
Lucas Barrett.—On the Atlas and Axis of the Plesiosaurus.
S. Baines.—On Yorkshire Flags with Fossils.
Professor Rogers.—On the discovery of Strata of supposed Permian Age in the Interior of North America, by Mr. Meek and other American Geologists.
John Wolley, Jun., M.A.—Observations on the arrangements of the small Stones on certain bare levels in Northern Localities.
W. Matthews.—Photographs of the Rowley Rag Quarry at Ponk Hill in Walsall.
T. W. Atkinson.—Volcanos of Central Asia, commencing with the Baikal in Oriental Siberia, and extending into Mengalid and Chinese Tartary.
Alphonse Gages.—On some Molecular Phenomena produced by the action of Acids on Hydrous Magnesian Rocks, &c.
Professor Owen.—On a new Genus and Species of Pterodactyle, with remarks on the Geological Distribution of the Flying Reptiles.
Sir R. I. Murchison.—Results of recent research among the older Rocks of the Scottish Highlands.
Professor Nicol.—On the Age and Relations of the Gneiss Rocks in the North of Scotland.
David Page.—On the Relations of the Metamorphic and older Palæozoic Rocks of Scotland.
Dr. Anderson.—On the Fossils and Yellow Sandstone of Dura Den.
Stephen Eddy.—On the lead-bearing districts of North Yorkshire.
W. H. Baily.—On the new Species of Crustacea from the Coal Measures in Queen's County, Ireland; and some remarks on forms allied to them.
————— On the fructification of Alethopteris (Cyclopteris) Hibernica, from the Upper Devonian or Lower Carboniferous strata at Kiltorkan Hill, County Kilkenny.

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ON THE MARINE SHELLS OF THE SOUTH WALES COAL-BASIN.

By G. P. Bevan, M.D. F.G.S.

(*Read before the British Association, at Leeds, September*, 1858.)

Until of late years, the South Wales coal-field was considered to be very barren in fossils, and those few which were known were all thought to be of land or fresh-water origin. During my endeavours to work out the geology of this district for the last four years, I have, however, discovered sufficient to redeem it from such a reproach, and to prove that not only are there fossils, but that these are even in great numbers and variety.

The basin, which occupies portions of Monmouthshire, Glamorganshire, Breconshire, and Carmarthenshire, may be separated into two great divisions, both geologically and chemically. The first is the division into upper and lower coal-measures, separated by a thick mass of Pennant sandstone, or grit, while the chemical is the division into bituminous and anthracitic coals. The upper measures are principally found in Glamorgan and Carmarthenshires, the only coal-seam of that series in Monmouthshire, being known as the Mynyddswlyn vein. Westward of the Taff, however, which is the boundary between the two countries, the upper measures appear more frequently, and in more regular sequence; while, in Carmarthenshire, we obtain a complete section of these beds down to the Pennant rock, in the neighbourhoods of Llanelly, Penllergare, and Lloughor. The middle, or Pennant rock series attains its greatest development at Swansea, where it is 3,000 feet in thickness, and presents several important beds of coal; but in the eastern portion of this field they are very much thinner, and contain little or no workable coal. The summits of the hills which bound the parallel valleys on the north crop, are nearly all capped with this grit, which adds much to the peculiar configuration of the country, and gives a certain identity of outline to its general features. The lower measures are below this rock, and are mostly found on the north crop, where they can be most easily and conveniently studied, both from the gradual inclination of the beds, and the comparatively small amount of disturbance that has taken place amongst them. They are also to be found on the south at Pentyrch, in the Taff Vale, Cefn Cubwr, near Bridge-end, Clive Moor, near Swansea, and Penclawdd in Gower; but the greater inclination of beds, and the frequent interruptions to the series, render them less convenient for the geologist. Having premised this general outline, I will now proceed to offer a few remarks on the fossil remains. As far as I have been able to examine the beds of the upper measures, I have not found anything in them beyond vegetable remains, which are tolerably plentiful; but no appearance of shells, nor any traces of fish. In the lower measures, however, I have been more fortunate, and have obtained both in considerable numbers. The average aggregate thickness of the beds of this series is about forty-seven feet, while that of the respective veins is from two to ten feet. In this accumulation of beds—which, with underclays, seams of iron-ore, sandstones, argillaceous and arenaceous shales, we may roughly compute at fifteen or sixteen thousand feet—we have seven or eight zones of animal life, showing periods when either brackish water or irruptions of the sea prevailed. As, unfortunately, a great difference of nomenclature prevails over the whole basin, and as many seams of coal, called by particular names in one district are called by a very different name in an adjacent locality, I will limit my description to one portion of the field, and confine myself to the local names of the north-east crop.

Passing over the marine forms of the mountain-limestone, we first come to the millstone-grit, which rather thickens in its course from Pontypool to Merthyr. Conformably on this lies a mass of rock of about forty yards thick, known as the "Farewell Rock," so called because the colliers, when they have struck this rock, consider that they lose all further traces of coal. This is, however, a misnomer, for there are in it two or more seams of coal, generally thin, but often good and workable, and a good deal of ironstone. These seams are termed "Rosser veins," and I think it advisable that the term "Farewell Rock" be discarded, and the name "Rosser Rock" substituted. It is in these seams that a bed of marine shells occurs, which I have traced for more than fifty miles along the greater portion of the north crop—in some places occurring in coal-shale, in others in ferruginous clay and ironstone. It is probable that the early condition of these beds was that of a huge delta or estuary, and that the mollusca sought the shelter of the bays, that they might enjoy comparatively still water. They are all of the mountain-limestone series, as the following list will show, and it is interesting to notice that the carboniferous limestone shells were not cut off entirely at a certain period or line, but that some species found their way very high up into the true coal-measures. I have obtained from these beds—

Actinocrinus
Cythere (species)
Athyris planosulcata
Chonetes Hordrensis
C. variolata
Discina nitida
Lingula mytiloides
L. elliptica
Orthis filiana
O. Michelini
O. resupinata
Productus Flemingii
P. concinnus
P. semireticulatus
P. spinulosus
Spirifer pinguis
Aviculopecten
Axinus carbonarius
A. sulcatus
Edmondia
Nucula tumida
N. lævirostrum
Modiola
Mytilus
Myacites angulata
Sanguinolites
Unio
Venus elliptica
Conularia quadrisulcata
Holopella
Macrocheilus
Murchisonia
Natica vetusta
Turritella
Goniatites falcatus
G. Listeri
G. reticulatus
Bellerophon hiulcus
B. Urii
Nautilus
Orthoceras cinctum
O. scalpratum
O. (n.s)

The next zone of life that we find is in the shale of the bottom vein, which is a seam of coal from 1 ft. 6 in. to 2 ft. in thickness, lying on the Rosser Rock. In these shales are scattered fish-remains, jaws, teeth, palates, bones, rays, and scales, belonging to *Amblypterus*, *Ctenacanthus*, *Helodus*, *Ctenoptychius*, *Palæoniscus*, *Holoptychius*, *Cœlacanthus*, and *Psammodus*, while one shell only has been found at Ebbw Vale, *Spirifer* *bisulcatus.* Next in successive order is the "Blue Vein" ironstone, which abounds in *Anthracosia aquilinus* and *Spirorbis carbonarius*, and much more rarely, a species of *Modiolopsis*. Above this is the "Red Vein" ironstone, from which I have obtained *Cardiomorpha.* Then comes a coal-bed, about four or five feet thick, known in the north-east crop as the "Old Coal," and about Merthyr as the "Lower Four-foot Coal," in the shale of which two species of *Unio* occur, together with a small *Modiola.* In the rock below this coal at Beaufort I have observed well-marked traces of a small crustacean. Many such traits, I have no doubt, would come to light by careful search, for there must have been an enormous amount of surface exposed in the wet sands and mud of that age, although at present we know but little of their remains. Above the Old Coal are two or three seams in which no fossil remains have been noticed, with the exception of one or two ferns and *Lepidodendra ;* but shells again appear in the shale of the "Dawen Pins," in the shape of *Unio centralis,* which is very abundant, and *Myalina quadrata,* which is more scarce. Above this is the "Bydellog Coal," an important seam, running through the greater part of the district, and averaging from five to ten feet in thickness. At Ebbw Vale one shell has been procured from this coal, an *Athyris planosulcata,* while in the shale of the equivalent coal at Pontypool, called there the "Meadow Vein," *Productus scabriculus* is common, the only Productus known in the true coal-measures. Above the "Bydellog" is the "Three-quarter Coal," which has yielded (although I cannot vouch for the accuracy of the locality) a *Terebratula hastata.* It was found in the rubbish-ground of this coal by Mr. Adams, of Ebbw Vale, but he was not absolutely certain that no shales from another coal might not have been accidentally mixed with it. This is, at all events, a mountain-limestone shell from the true coal-measures, and if it be from the "Three-quarter Coal," it is the highest range of the species in the coal-basin, being between six and seven hundred feet above the mountain-limestone. A seam of coal immediately above this, the Elled, has given us no shells, but an amazing quantity of ferns in beautiful preservation, of which I possess more than forty species; but, as they are foreign to the present subject, I will not now enumerate the list.

A small vein of ironstone, the "Black Pins," lies about ninety feet above the Elled, in which *Unio aquilinus* is tolerably common. In the "Soap Vein" of coal, a small seam higher still, a shell, probably *Unio,* has been found, but it is difficult to determine from its bad state of preservation.

I have now enumerated ten separate periods in which animal life, for the most part of distinct species, existed, during the times of the several deposits of coal-beds and ironstones from the period of the mountain-limestone up to the Pennant rock, and I have no doubt that more continuous research will prove that we must not limit too strictly our line of demarcation.

DESCRIPTION OF THE SECTION OF THE UPPER GREENSAND AT THE UNDERCLIFF, IN THE ISLE OF WIGHT.

By Mr. Mark W. Norman.

(Continued from page 480.)

The next division, 8th, consists of a bed of fawn-coloured sandstone of about ten feet in thickness, containing nodules of rag, with *Pectines*, *Terebratulæ*, *Rhynchonellæ*, *&c.*, in the lower portion, which, owing to its softness and looseness of texture, the weather wears away, leaving the shells finely exposed. It is chiefly owing to such excavation of this bed, by the combined influence of the elements, that those great falls of the superincumbent masses have taken place at intervals along the line of the Undercliff, many such "founders" having happened within the memory of residents, and others being likely to occur constantly from this hard and solid mass of strata resting on an insecure foundation, the effects of which are still further increased by the presence of the Gault below.

But a few years back a large mass near Blackgang thus assumed such a dangerous and threatening attitude, by the lower part of it being so much worn away, that the authorities blew it down with gunpowder. Many thousand tons of rock and *debris* were thus thrown down, completely blocking up and destroying the original road; one huge mass still stands close to the road, as large and as high as a good-sized cottage.*

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* Gore Cliff, below which occurred the great landslip, in the month of February, 1798, when, during a severe frost, an entire tract of land, on which was a farm, called Pitlands, became separated from the Cliff, and descended towards the sea, burying the farm-house and carrying with it in its progress rocks, trees, and

A layer of rag-stone, called the "Big Rag-bed," containing fossils, terminates what is termed the "sandstone-group."

9th. The sixth division extends from the above down to the Gault, and is about thirty feet thick. It is composed of alternating beds of rag of about a foot each in thickness, with a brittle argillaceous sandstone, being more dark and mottled, and differing widely both in colour and substance from the beds above as it gradually approximates to the Gault; ultimately appearing as a layer of white or rubble gault, as it passes into that deposit. The fossil contents are a small species of *Astacus*, characteristic both of the sandstone and rag, bivalve-shells, including *Pectines*, and a large species of *Inoceramus*, some of the hinges of which are half an inch in thickness, and the valves from six to nine inches long; the hinge-teeth are often well preserved. On nearer approach to the Gault the fossils are so friable as to be incapable of extraction.

This group ends the series of deposits of the Upper Greensand in the Isle Wight.

herds. In a letter dated Niton, Feb. 9th, 1799, in the "Isle of Wight Magazine" for that year, an account is given of this catastrophe:—"Dear Sir,—Yesterday I was desired by your tenant, farmer Harvy, to go down to Pitlands, to take a view of your cottage there, in order to communicate to you what follows. About Tuesday last, the whole of the ground from the Cliff above was seen in motion, which motion was directed to the sea, nearly in a straight line. Harvy perceived the house to be falling, and took out the curious antique chairs. The ground above beginning with a great founder at the base of the Cliff, immediately under St. Catherine's Down, kept gliding forward, and at last rushed on with violence, totally changing the surface of all the ground to the west of the brook that runs into the sea, so that now the whole is convulsed and scattered about, as if it had been done by an earthquake. Of all the rough ground, from the cottage upward to the base of the Cliff, there is scarcely a foot of land but what has changed its situation! the arable fields are likewise convulsed, but not to the degree that the rough ground is; as far as the fence is from the Chale side, the whole may be called one grand and awful ruin. The cascade which you used to view from the house at first disappeared, but has now broken out and tumbled down into the withey-bed, of which it has made a lake; this last appearance is owing, I suppose, to the frost, which prevents the water from running off. The few trees by the cottage, at the base of the rock on which you had placed a seat, have changed their situation, but are not destroyed. Harvy wanted, when I was there, to go into the house to fetch some trifling articles, but I dissuaded him; and very well I did, for soon after the wall to the west sunk into the ground. What damage is done, besides that which the house has suffered, I cannot say. The whole surface, however, has undergone a complete change; and at present there are everywhere chasms that a horse or cow might sink into and disappear. This seems to be an eventful period with us. Where your property is, there is a founder from the top of the Cliff, in that piece of land which Dixon rents, that has nearly covered the whole with fragments of free-stone."

FOSSILS OF THE UPPER GREENSAND.

Intermediate Beds.

- Ammonites varians—4 or 5 varieties
  - Mantelli ?—two varieties
  - Coupei
  - falcatus—rare
  - Vectensis—very rare
  - navicularis
  - Rhotomagensis, var.
  - Goodhalli
- Nautilus lævigatus
  - expansus—common
  - elegans—rare
  - pseudo-elegans—common
  - radiatus—rare
  - undulatus—rare
  - Largilliertianus—rare
- Turrilites Morrisianus—common
  - Bergeri
  - costatus—rare
  - tuberculatus—rare
- Ancyloceras—four varieties, common in fragments
- Toxoceras—two varieties, in fragments
- Hamites elegans (?)—rare
- Baculites—two varieties, common
- Belemnites minimus—rare
- Ostrea carinata—rarely perfect
  - vesicularis—several other varieties
- Anomia (?)—rare
- Lima—several varieties
- Exogyra—common
- Pecten orbicularis—2 varieties, common
  - Milleri (?)
  - asper—common
- Wood—friable and decayed
- Resin—rare
- Pebbles of quartz—rare
- Rhynchonella sub-plicata—common
- Terebratula prælongata—common
  - carnea—common
  - sella (?)
  - Several other species, amongst which is that which resembles the recent T. caput-serpentis; also, an elegant little shell much resembling Magas pumilus of the Upper Chalk.
- Spongia—two species
- Echinus ?, *sp.*—a small species, rare
- Spatangus ?, *sp.*—rare
- Millepora, *sp.*—common
- Flustra, *sp.*—common
- Coral, *sp.*—rare
- Astacus ?, *sp.*—claws of, rare
- Serpula—two or three species
- Casts of species of Fusus (rare), Natica (common), Nerita (common), several species of Trochus (common), Pleurotomaria (common), several species of Tornatella, Venus (common), and Thetis (common).
- Tellina (?)—common
- Cardium—common
- Arca Rauliniana (?)—rare
- Bones and Teeth of several species of Shark—common
  - Saurians—rare
  - Crocodile—rare
- Chelonian remains
- Bryozoa, innumerable fragments of
- Worn pieces of Ammonites and other fossils

Chloritic Marl.

- Radiolites—rare
- Cidaris, Spines of—rare
- Pecten asper—two varieties, common
  - quinque-costatus—common
  - orbicularis—numerous
- Ostrea carinata—rare
- Exogyra, *sp.*—common
- Serpula—two or three species
- Saurians—teeth and bones of, rare
- Choanites ? *sp.*—common, much flatter than those found in the chalk
- Nodules interspersed with fragments of comminuted shells:—
- Echinus ?—two varieties, common
- Spatangus ?, *sp.*—common
- Cidaris, *sp.*—rare
- Spines of Cidaris—rare
- Sponges, two or three varieties of—common
- Choanites, Siphonia
- Alycyonia
- Bryozoa

FIRESTONE AND GREAT CHERT BEDS.

These beds are but sparingly fossiliferous in the upper portion. The most charasteristic fossil is the large *Pecten quinque-costatus.* The chert itself, according to Mr. Martin, contains vast quantities of zoophytic remains, apparently spicula of sponges and Spiniferites, as may be seen with a good microscope. The lower portion contains

- Nautilus radiatus
  - expansus (?) very large
- Ammonites rostratus (?)
  - inflatus
- Ammonites, *n. sp.*
- Belemnites lanceolatus
- Rhynchonella plicatilis
  - octoplicata
  - subplicata
- Pecten orbicularis, two varieties
  - quinque-costatus, common
- Ostrea vesicularis
- Casts of Venus or Thetis
- Spondylus, *sp.*
- Echinus (?)—two species
- Siphonia, Choanites, and other sponges
- Bones and teeth of sharks and saurians
- Fossil wood

At the bottom of one of the alternating beds of blue rag, large masses of oval-shaped echinites occur in groups of from three to a dozen; they resemble the *Ananchytes ovatus* of the chalk. They are largely permeated with iron, and are so firmly embedded in the surrounding matrix that to extract them is a work of great difficulty; but it sometimes occurs that the wash of the sea accomplishes that which the hammer fails to do, and specimens are often thus brought to light exhibiting the beautiful construction of the shell, and its division into the armour-like plates of which it is made up. The author discovered a year or two since, in these beds, a single vertebra of a large saurian, the *Streptospondylus* (?), and it is now in the British Museum; such remains are very rare.

Fossil wood is common in these beds; it is white and silicified, but many specimens are beautifully coloured by infiltration of iron. The author has now in his possession a large piece of a longitudinal section of a tree about eighteen inches in circumference, with the bark entire, which is an inch thick, and of a brown ochreous tint; the wood has annular rings of growth, and is much perforated by boring shells. It is probably dicotyledonous, and belonging to a cone-bearing species. It was also from these beds that the fine specimen of *Clatharia Lyelli*—figured in "Mantell's Excursions," at page 217—was obtained, and not from the chalk-marl, at Bonchurch, as is there erroneously stated, that specimen came from the "great chert beds" in the quarry above Steephill Castle, and was found by a workman whilst excavating stone for building, and sold by him to Captain Ibbetson.

Such portions of wood and vegetable remains as are found in the Roman Chalk of this locality, are always in such a decayed and decomposed state, and in such small fragments, as to be utterly valueless for the purposes of scientific determination.

FREESTONE AND SANDSTONE BEDS.

- Sponges—many varieties
- Siphonia, *sp.*
- Belemnites lanceolatus (?)
- Pectines, *sp.*—rare
- Ammonites—very large, rare
- Nautilus elegans—rare
    - expansus
- Sponges, species of
- Terebratula, *sp.*—abundant
- Exogyra, *sp.*
- Lima—two species or more
- Wood—several kinds
- Serpula—several species
- Hamites—three species
- Echinus, (?) species of
- Spatangus, (?) *sp.*
- Natica, *sp.*
- Spines of fish
- Hypsodon Lewesiensis, in British Museum, discovered by the author
- Pleurotomaria, *sp.*
- Sharks' teeth and bones, several species of
- Fish-bones
- Ammonites—three or four species
- Nautilus, *sp.*
- Ostrea carinata
- Fusus (?), *sp.*
- Astacus (?), *sp.*
- Mya—two species
- Gervillia—two species
- Modiola, *sp.*

MALM-BED.

- Ammonites rostratus?
- Ammonites, other species of
- Nautilus, *sp.*
- Millepora, species of
- Gryphæa, *sp.*
- Inoceramus (?), *sp.*
- Serpula—three species
- Lima—two or three species
- Crustacean remains
- Fish-teeth and scales—abundant
- Sharks' teeth and bones—rare
- Alcyonia, *sp.*
- Sponges, species of
- Siphonia, *sp.*
- Pecten quinque-costatus
    - „ dequicostatus
    - Other species
- Spondylus, *sp.*
- Ostrea vesicularis
- Anomia (?) *sp.*
- Inoceramus, large *sp.*
- Pinna, *sp.*
- Hamites—large *sp.*
- Cardium—several species
- Trigonia aliformis
- Panopæa mandibula
    - plicata
    - three other species of
- Actæon, or Tornatella—several species
- Wood, fragments of
- Belemnites minimus (?)
- Pleurotomaria—two species
- Natica *sp.*
- Scalaria (?) *sp.*
- Terebratula—three or four species
- Coprolites,

Casts of species of Venus (?), Thetis, Tellina (?), Cytherea, of Trigonia spinosa, T. carinata, and two other species or varieties, and of Mya, Modiola, Rostellaria two varieties, and Mæandrina (?).

THE SPIRIT OF GOOD BOOKS.

CAMBRIDGE ESSAYS, 1857.—GEOLOGY: BY W. HOPKINS, M.A., F.R.S., F.G.S.

(*Continued from p.* 425.)

In the preceding exposition the object has been to give, in a condensed form, the leading facts and conclusions of geology. These facts are so firmly established by observation, and the conclusions from them so clearly demonstrated, that every rational mind must assent and be prepared to admit the principle on which Geology, like all physical sciences, must rest—that geological phenomena must be referred to physical causes.

When the student has obtained sufficient familiarity with these established propositions, he will be prepared to follow in the discussion of the less elementary problems of the science, many of which are subjects of controversy. Before, however, going into these speculations, Mr. Hopkins devotes several pages to the evidences of the vast antiquity of the globe, dwelling both on the evidences afforded by the organic remains of successive creations embedded in the rocks, and on those drawn from the inanimate kingdom. Of the first we find that an immense number of different tribes of animals and plants which in former ages have given their passing phases to terrestrial life on our planet have disappeared with a transition so slow that, according to the present order of nature, there is not the slightest evidence of the introduction of a new species of animal since the creation of man; whilst of the latter, it appears certain that the deposition of sedimentary strata, and that process of denudation necessarily contemporaneous with it, must have proceeded at very much the same rate in former as in recent times; and, admitting this conclusion, we obtain something like a rough conception of the enormous lapse of time necessary for the deposition of the whole mass of sedimentary formations, by simply comparing such mass with the proportion which has been transported and deposited within the last two or three thousand years.

Particular cases have thus occasionally been considered with respect to the deposition of certain limited masses, as, for instance, the delta of the Mississippi, has in this manner been computed at a minimum period of some 60,000 years.

The history of our globe presents to us a continual struggle between two antagonistic operations, denudation and elevation. The question of the causes of these operations is still matter of controversy, which, as well as many other speculations, Mr. Hopkins purposely avoids discussing, except so far as it may be necessary to do so in the consideration of two of the chief speculative questions, to which the study of geology naturally leads, and to which the remainder of his essay is devoted.

One of these speculative questions is, Whether we find distinct evidence of a *progressive* change in the physical condition of the globe; or whether such changes as we may recognize in past times are only recurring *periodical* changes, sometimes taking place, as it were, in one direction, sometimes in another, so as not to alter what may be termed the *mean* condition of the earth, but so as to leave it, during all past time, in a physical condition not essentially differing from that in which it now exists.

The *progresssive* theory is advocated by some of our best geologists; the *non-progressive* by others of eminence. The advocates of the latter are sometimes also designated *uniformitarians*.

The other speculative question relates to the appearance and disappearance of successive creations or of new forms of animals or vegetation, specifically distinct from those which preceded them. Hence, "Is the introduction of these new orders of organic beings to be referred to any cause which can properly be included in those secondary causes which, in their operations and effects, constitute what we term *nature*, in the usual acception of the term; or are they to be referred to some higher order of causation, which may be best represented as a more immediate act of creative power?

In the discussion of these questions it is essential to enter upon other collateral physical questions themselves important points of investigation. "The great all-pervading physical agent to which the changes of this earth's condition are due, is *heat*." It is heat which vaporises the waters of the ocean, and lifts them above the mountain-tops, thence again to descend laden with sediment to their native bed; and to the same cause we must trace the winds which raise the waves, and give to them their power to undermine and cast down the loftiest cliffs. A large part of the denudation, therefore, is due to this cause, and it is to heat alone, under any view of the subject, that we can possibly assign the agency by which continents and mountains have been elevated, while its milder influences are traceable in the past changes of climate in certain regions at least, of which geology bears no doubtful evidence.

Within a depth of from fifty to eighty feet from the surface, the terrestrial mass is affected by the change of temperature from one season of the year to another, the effect becoming less sensible as we recede, until it becomes so small that a thermometer, placed at the depth above mentioned, indicates the same temperature at all seasons of the year. The temperature at this limiting depth exceeds by about one degree the mean annual temperature of the ground just below the surface, and that of the atmosphere just above it, and within this limiting depth the variation of temperature is due to entirely solar influence. But the point with which we are immediately interested is the law of temperature below this limiting depth of fifty to eighty feet. The *rate* at which the temperature increases as we descend, varies in different localities; but where the depths are great we find a close approximation to a common rate of increase which, as determined by the best observations in the deepest mines, shafts, artesian wells in western Europe, is very nearly 1°F. *for an increase in depth of sixty feet.*

In the consideration of the changes of climate which have taken place at different geological periods, the author dwells on those characters of fossils, shells, plants, &c., by which the extinct organisms are related to particular existing geographical groups, or to particular local faunas and floras, geological evidence being considered as generally in favour of former higher temperatures. There is no distinct evidence, however, to show whether change of climate was or was not accompanied by any *oscillation* of temperature during the Palæozoic and Secondary Periods; but when we come to a portion of the later Tertiary Era—the glacial period—we find evidence proving a large portion of Western and Northern Europe to have been, during the period in question, considerably colder than at present, and consequently of considerably lower temperature also than that of the preceding periods, thus establishing a large oscillation of temperature in reference to this particular region. The fossil fauna, too, of the glacial period, bears a decidedly Arctic aspect.

The interior higher temperature of the earth, the higher climatal temperature of the early geological periods, the lower temperature of the glacial periods, the earth's form and density, together with the astronomical phenomena of the precession of the equinoxes, and the corresponding inequality in the moon's motion, must all be accounted for by any complete geological theory. In proceeding, then, to theoretical considerations, in the first place we may remark that the spheroidal form of the earth could not fail to suggest the idea of fluidity—a state to which no conceivable cause but excessive heat could reduce it, but which was not necessarily the earth's primitive state, but an antecedent state through which it must have passed before it became solid.

Moreover, the observed increase of temperature in descending beneath the earth's surface suggested the notion of a central incandescent nucleus still remaining in a state of fluidity from its elevated temperature. Hence the theory that the exterior crust had assumed its present solidity by the radiation of heat into surrounding space and its consequent refrigeration.

This central heat was formerly thought a sufficient cause for the more equable climate over the earth's surface at remote geological periods; but it manifestly could not account for a temperature in this glacial period so much *colder* than at present. This fact has led to a more careful investigation of these causes, and these are found in the relative disposition of land and sea, and the effects to be more especially influenced by the ocean-currents of warmer or colder water.

The influence of the Gulf-stream upon our own climate is well known, and with such a powerful example of climatal alteration before us, we must be cautious how we appeal to other causes as necessary to account for a higher temperature.

The rival theory of this primitive and central heat is that which attributes the internal terrestrial temperature, as well as volcanos, to *chemical action.*

The question of a continuous progression of our globe from a primitive towards a final physical state considered with reference to the evidence supplied by organic remains on the question of progression or non-progression, has, perhaps, been more or less associated in the minds of speculative geologists with that of the *transmutation or permanenee of species.*

Mr. Hopkins discusses here the necessary distinction of a species; but without following him in those remarks, we enter at once into the main topic.

The question really involved is that of the transmutation or permanence of species is, whether species—using the term in its wider and more unrestricted sense—have any existence in nature or not.

That different races of animals have been introduced on the face of the globe at successive epochs, is testified by their fossil remains, hence the question of transmutation or permanence of species has a high geological interest; and those who wish to study the details of this question, may refer to Sir Charles Lyell's presidential address to the

Geological Society in 1851, and to the review of it shortly after in the "Quarterly Review."

The subject will, however, be better presented to the minds of most of our readers through the medium of general facts. According to existing evidence it appears that invertebrate animals alone existed in the earlier palæozoic period. Fishes were then introduced and existed in great numbers in the Devonian period; and shortly afterwards reptiles appeared. Small mammals existed in the Middle or Mesozoic period, the whole class becoming completely developed only in the latest geological era. The remains of birds, as might be expected, are comparatively very rare. The introduction of man is the great and final step in this progressive series.

These facts, and numerous others, are calculated to refute both the extreme theories before mentioned—that of the complete development of organic life by successive steps, from the lowest and simplest forms to the highest and most complicated, terminating in man; and that which maintains that there has been no progression at all.

But because the proof of one theory is imperfect, we are not therefore to reject it wholly because of the incompleteness of the proof. We have a large amount of positive evidence in favour of progression; on the other hand, we are not aware of any positive evidence whatever in favour of non-progression, and we are called upon by its advocates to believe it, because future discoveries may supply such evidence.

Mr. Hopkins now discusses the question, How were new species of animals originally introduced on the face of our globe? and inclines to the opinion that their introduction was distinct from any progressive transmutation of species according to any actual law of nature, and consequently *supernatural.*

Geoffrey St. Hilaire, at the close of the last century, was one of the earliest leaders of the school of transcendental anatomy, as it has been termed. In his views St. Hilaire was directly opposed to the great Cuvier himself, whose labours assuredly laid the foundation of that branch of palæontology which relates to the vertebrata, and which has been since so successfully prosecuted by his successors, and by none more so than our distinguished countryman, Professor Owen.

With the advance of knowledge of animal organziation, speculative naturalists began to search for generalizations of a higher order than those of mere zoological classification, and many of them adopted the principle of a *unity of plan* pervading the entire range of animal organization. The poet Goethe was one of the first who entered into these speculative views, which resolved themselves practically into endeavours to discover a form which should serve as *a type* of all organic forms in the animal kingdom, according to the fundamental notion of a *unity of plan,* and this object was restricted for a time to the vertebrate skeleton. In the vertebrata the persevering researches of distinguished naturalists have been crowned, it is considered, with success, although they are still far from being agreed as to the precise typical form. That proposed by Professor Owen—a naturalist possessed of the boldness of this school of trancendentalists, tempered by the true spirit of inductive philosophy—being regarded as having the strongest claims to confidence.

According to these views, every vertebrate skeleton is divided into a number of transverse segments, perpendicular to the general direction of the vertebral column or back-bone, each segment of the neck, the back, and the tail, comprising a single vertebra, and each segment of the head comprising a bone analagous to a vertebra. Immediately above the central bone of each vertebra (the spinal column being supposed horizontal) is the *spinal canal*, extending from the head to the tail, and containing the spinal-chord, which is a continuation of the mass, constituting the brain, the cavity of the skull being regarded as no expansion of the spinal canal; and so with the limbs, and throughout the entire organized frame, each segment of the body, however modified, being regarded as the homological equivalent of each and every of the others.

The opposition of the early transcendentalists to the doctrine of final causes—as the argument of Cuvier, of the adaptation of the organs to the fulfilment of pre-ordained and special purposes is called—has contributed to create a suspicion in the minds of many persons that all such generalizations of the phenomena of organic life were inimical to the latter doctrine, and tend to the notion that the adaptions and harmonies of the *adaptive modifications* are in subservience to the general laws. This mode of expression ought rather to be inverted, and it should be asserted that these laws were impressed upon matter in subservience to the ends to be obtained. Mr. Hopkins hence goes on to speculations on the future conditions of our planets. "The character of a geologist," he says, "is essentially that of a historian; but it is impossible for him, at times, not to assume something also of a prophetic character, and endeavour to stretch his mental gaze into the far future, as he habitually directs it to the remote periods of the past. In venturing such speculations in regard to the future of our globe, even those extended chronological conceptions of time, which the contemplation of geological phenomena has given, must be enlarged, and we must look forward to times indefinitely more distant than those to which we may have hitherto looked in our most remote anticipations of the future."

As in the past history of the earth we have seen the important influence of heat, so, in turning to the future of our planet, we are led first to inquire what may hereafter be expected to result from that universal agent in physical change? and on this topic Mr. Hopkins concludes "that the terrestrial heat is probably at presant, or must be hereafter, reduced so as no longer to be of sufficient intensity to produce a recurrence of those stupendous upheavals and dislocations which have taken place in past times.

The principal argument against the notion of any diminution of intensity in the causes of such movements is based on the fact that some of the existing mountains—the Alps, for example—do not date from an earlier period than the early Tertiaries.

The next consideration is the future change of climatal conditions. The mean annual temperature of the earth's surface depends on solar and other external influences, the temperature of the surrounding planetary space, and the constitution of the earth's atmosphere.

It must, also, manifestly depend in part on the central heat, assuming such to exist. The mathematical solution of the problem tells us that so little depends on the latter cause, that although the centre of this globe may consist of a mass of molten matter, the temperature of its surface would not thereby be increased by more than the small fraction of a degree; and Poisson has calculated that "it would require a *thousand millions of centuries* to reduce this fraction of a degree by half its present amount."

The continued reduction of the earth's temperature, and the consequent diminished intensity of all subterranean action, would be followed, in the process of time, by a somewhat startling result. The processes of denudation and of elevation have hitherto preserved the balance of sea and dry land; but if the elevatory movement should thus cease, while the denuding forces continue to act with unabated energy, "the inevitable result would be, that every mountain-top would in time be brought low. No earthly barrier could declare to the ocean that there its proud waves should be stayed. Nothing would stop its ravages till all dry land should be laid prostrate, to form the bed over which it would continue to roll an uninterrupted sea.

But when we contemplate the change produced by such immeasurable periods of time, we are led to ask, Will the external conditions of our planet be such as now exist? will the sun give the same light and heat? will the earth move in the same orbit? will the whole solar system maintain the same relative position to the stars which now surround it?

"The heat and light which the earth derived from the sun in the most ancient geological periods cannot have been very different from that we derive from him at present. We are too ignorant, however, of the sun's mass and nature to have sufficient foundation for definite speculation."

"According to the present order of nature, heat is largely dissipated from the sun and stars into surrounding space, and unless there be some means by which its reconcentration may be hereafter effected, or some inconceivable cause for the generation of heat *ad infinitum* in the sun's mass, it is certain that he cannot continue to radiate the same amount of heat as at present."

It is a noble conclusion of the mathematical philosopher that the solar system is framed to last for ever, provided the space in which it exists is an actual vacuum; if, however, the planetary space is not a perfect vacuum, but filled with matter—however rare and ethereal that matter may be—offering the slightest possible resistance to the motions of the planets, the doom of the system is sealed. For evidence of the existence of this ethereal matter forming what is termed a *resisting medium*, we look especially to the comets as the lightest bodies of the system, and therefore the most sensitive to such a medium. But the only testimony as yet is the periodic retardation of Encke's comet.

Until within the last few years, the motion of the whole planetary system through space was only a matter of speculation, but astronomers have estimated both the direction and velocity of the motion.

Such determination is at present necessarily somewhat vague; but, if only approximately correct, it might require nearly a million of years for the system to traverse a space equal to that which separates us from the nearer fixed stars: and within some such period, therefore, our relative position with reference to the stars around us may be entirely altered, and the external condition of the whole solar system changed.

Cosmical causes may thus modify, in we know not what degree, the terrestrial temperature, arising either from the earth's greater proximity to other suns, or the passage of the solar system through warmer regions of space.

Although such speculations as these may establish no positive views respecting the remote future of our globe, they appear to establish a powerful argument against the theory of non-progression; for there is nothing from which we should infer the permanence of the existing aspect of nature.

And, if we turn to man, regarding him independently of any revealed knowledge of his future destiny, do we see in his character and position here any indication that this earth is his destined abiding place for indefinite periods of time? A negative answer to this question is suggested, at least by the *finiteness* of the earth's surface and its powers of production, whereas the tendency in human population to increase is unlimited. And under the influences of Christianity and of that higher civilization which must attend the pure doctrines of our religion, we can hardly understand how the diffusion of our race can be effectively and finally arrested before the population of the globe shall have approximated to that limit which must be necessarily imposed upon it by the finite dimensions of man's dwelling-place.

"It may possibly appear to some that we have almost transgressed the legitimate bounds of human speculation, and that it might be more consistent with a becoming humility to leave the future, at least of the material universe, without too much curious questioning in the hands of Him to whom alone it can be really known. But it would seem consistent with the noblest purposes of man's intellectual existence that he should employ the mental faculties which have been vouchsafed to him, in the endeavour to catch some glimpses, however imperfect, of those laws and principles on which the government of the material universe is founded. Let this be done in a modest and reverential spirit, and we are sure that it will be found to be a healthy and purifying exercise of the mind, and one of the highest sources of intellectual enjoyment."

Extended as is this notice of Mr. Hopkin's Essay, we have omitted a great deal which might be perused to good advantage by other that tyros in the science; and we are only doing justice to the author when we say that this production is one which should have a place on the shelves of every geological library.

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Geological Odours—Organic Smells and Mineral Odours—Odour given out by Black Limestone—Ozone produced by Quartz—Hydrochloric Acid in Nature—Chlorine in ancient Volcanic Products—Sulphurous Acid and Sulphuretted Hydrogen—Gases Devoid of Smell—Naptha present in Active Volcanos—Perpetual Burning Springs—The famous Asiatic Chimæra—A Fire that has Burnt for Several Thousand Years—Gaseous Emanations of Tuscany—Boracic Acid—Fumarolle and Lagoni—The Peat-bogs of Suder-Brarup—Errata.

Our readers probably will not have forgotten the account we laid before them in May last, concerning the odour of the antediluvian seas. Geological odours, or odours emitted naturally from rocks or minerals, are interesting on this account—that they are not common. We are speaking, of course, of characteristic odours. Indeed, hardly a rock or stone exists but which, having condensed in its pores certain gases, emits them with their peculiar olfactive properties, when breathed upon or when wet. Thus, many persons have doubtless, like ourselves, had frequent occasions to remark the peculiar odour which arises suddenly from the earth in the country roads, as well as in the streets of our cities, the moment a heavy summer-shower of rain begins to fall.

In organic nature odoriferous substances are very abundant, and many of them have actually been produced artificially by modern chemists. This is true, for instance, of the sweet essence of bitter almonds, the flavour of the apple (valerianate of amyl), of the pear (acetate of amyl), of pine-apple (butyrate of amyl), the strong-smelling oil of garlic (sulphate of allyl), &c. But, in the mineral kingdom, only a very few natural species may be distinguished from others by the aid of the olfactory nerve. Certain natural bituminous substances (and here we fall again into the organic world), such as naphtha, petroleum, &c., may be recognized by their peculiar smell; and among the strictly inorganic mineral species, sulphurous acid, hydrosulphuric acid, chlorine, and hydrochloric acid are the most powerful odorous substances known.

When mineral substances are acted upon chemically, the presence of many may be ascertained with certainty by the odours they then give rise to. For instance, arseniferous minerals, and compounds of selenium, which, when heated on charcoal before the blow-pipe, give out an unmistakeable smell of garlic and rotten cabbage; or, again, certain sulphides, when acted upon by a strong acid, evolve sulphuretted hydrogen; certain chlorides which, in the same circumstances, evolve hydrochloric acid, &c.

We have heard many persons speak of the smell of sulphur. Pure sulphur has little or no smell at all; but, when burnt in the air, it develops sulpurous acid, the pungent odour of which brings tears into the eyes. Certain black and dark-coloured limestones, particularly those of the coal and anthraciferous strata, develope, when broken or scratched, a peculiar odour, which has sometimes been attributed to sulphuretted hydrogen, or arsenuretted hydrogen; but, if I mistake not, Dr. Percy has satisfactorily proved that in many black limestones no sulphuretted hydrogen is contained; and it appears more probable that this odour is of organic nature, and due to bituminous substances contained in the limestones we speak of.

Every schoolboy is aware that when two pieces of quartz are rubbed smartly together in the dark, they produce a sort of electric light, or phosphorescence, which is, to a certain extent, a reproduction *en petit* of the grand phenomenon of sheet-lightning. A strong odour is emitted at the same time, and this, although I have made no actual experiment to prove it, I believe to be due to *ozone*—a peculiar condition or state of oxygen gas, which, though quite devoid of smell in its natural state, becomes, under the influence of the electric spark, and in various other circumstances, remarkably odoriferous, whilst, at the same time, its chemical properties are completely changed. The electricity produced by rubbing together the two pieces of quartz acts, it would seem, upon the oxygen of the air which surrounds them, and produces an odour of ozone.

The strong-smelling substances, sulphurous acid, hydrochloric acid, sulphuretted hydrogen, and perhaps chlorine, are present in active volcanos and solfatara. Hydrochloric acid is very common, for instance, at Vesuvius, where it is condensed by the aqueous vapour into an acid liquid; it is also found in certain mineral waters, and now and then it is evolved from beds or strata of rock-salt. Chlorine is frequently discovered in the pores of certain ancient volcanic products, such as those of the Puy-Sarcourg, in Auvergne. Sulphurous acid is extremely common in volcanic eruptions of all descriptions, and in the gaseous emanations of solfatara, &c., whilst sulphuretted hydrogen (hydrosulphuric acid) is most frequently perceived in dormant volcanos and certain mineral waters.

Pure carbonic acid, which is acknowledged to be the most important of all gaseous emanations, both on account of the abundance with which it is evolved and the number of localities in which it presents itself, is completely devoid of smell. The same may be said of nitrogen gas and proto-carbide of hydrogen, whilst deuto-carbide of hydrogen has a slight but very peculiar odour.

In mud-volcanos and salzes we have a production of sulphurous acid, carbides of hydrogen, naphtha, or other bituminous and odoriferous substances, besides certain gases which are devoid of smell.

A fact which is perhaps little known is, that naphtha is also present in ordinary volcanos; and this was actually perceived by the ancient writer Strabo, who relates that the elevated dome-like hill of Methano opened in fiery eruptions, at the close of which *an agreeable odour* was diffused in the night time. It is very remarkable that the latter was observed during the volcanic eruptions of Santorino in the autumn of 1650, when, according to Ludwig Ross, an "an indescribable pleasant odour" followed the stinking smell of sulphurous vapours. The same *pleasant odour* has been also noticed by Kotzebue, during an eruption of the newly-formed volcano Umnack, in the year 1804; and, during the great eruption of Vesuvius, on the 12th of August, 1805, Humboldt and Gay-Lussac perceived a bituminous odour prevailing at times in the ignited crater.

There is not much doubt left now that it is naphtha that burns in several of those remarkable productions of nature, the perpetual burning springs—more especially in the famous Asiatic Chimœra (in Lycia, on the coast of Asia Minor). In many springs of this kind it has been supposed that it was carburetted hydrogen gas (carbide of hydrogen) that burns. "We see issue from the ground," says Humboldt, speaking of gaseous emanations in general,* "steam and gaseous carbonic acid—almost free from the admixture of nitrogen—carburetted hydrogen gas, which has been used in the Chinese province of Sse-tschaun for several thousand years, and recently in the village of Fredonia, in the State of New York (U.S.), in cooking and for illumination." But it is difficult to account for so continual a supply of gas, always emanating from nearly the same spot. Indeed, this objection might be raised respecting naphtha, but it loses, perhaps, a little of its force in the latter case.

At the time Captain Beaufort visited the famous Chimœra in Lycia (he published his observations in 1820), it was thought to be a spring of burning carburetted hydrogen gas. Since that time the same spot has been visited by many travellers curious to see a perpetual fire that has been burning now for several thousand years, and which has been spoken of by Pliny,† Seneca,‡ Ctesias,§ Strabo,‖ among the ancients, and a host of more modern writers. Lieut. Spratt and Professor Edward Forbes found this spring as brilliant as ever, just as Beaufort had left it, perhaps even somewhat increased. They speak of *soot* being deposited by its flames;¶ this seems to prove that it is naphtha that burns, and not carburetted hydrogen, for the latter would deposit no soot. But what gives more probability to this assertion is the *agreeable odour* remarked near this spring by a more recent traveller, Albert Berg, a distinguished German artist.

The Chimœra rises from serpentine rocks associated with limestone, somewhat similar to the formation observed by Murchison and Parets in the districts of Tuscany, where the boracic acid *fumarolle* exist, of which we shall speak presently; and, curious to relate, it appears proable, from certain ancient traditions, that some of these boracic acid springs were once luminous (ignited) during the night.

At the bottom of a crater-like cavity, from which the combustible vapours issue in the Chimœra, is a shallow pool of sulphurous and turbid water, which is regarded by the natives of these parts as a sovereign remedy for all kinds of skin-disease.

Albert Berg has described the famous Asiatic Chimœra** as follows: "Near the ruins of the ancient temple of Vulcan rise the remains of a

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* *Cosmos*, Vol. I. † ii. 106. ‡ *Epist.* 79. § *Fragm.* cap. 10. ‖ Lib. 14.

¶ The Turks use this soot as a remedy for sore eyelids, and value it as a dye for the eyebrows.

** It is situated near the town of Deliktasch, in Lycia (Asia Minor), on the west coast of the Gulf of Adalia.

Christian church in the later Byzantine style. . . . . . In a forecourt situated to the east, the flame breaks out of a fireplace-like opening, about two feet broad and one foot deep, in the serpentine rock. It rises to a height of three or four feet, *and diffuses a pleasant odour*, which is perceptible to a distance of forty paces. . . . . At a distance of three paces from the flame of the Chimœra the heat it gives out is scarcely endurable. A piece or dry wood ignites when it is held in the opening and brought near the flame without touching it." And this magnificent phenomenon has been going on for several thousand years!

This bring us naturally to the subject of gaseous emanations, and we have at this moment before us a paper quite fresh upon the subject.

MM. Ch. Deville and Leblanc have been studying for some time past the nature of the gaseous emanations which accompany, as a rule, the deposit of boracic acid in the *lagoni* of Tuscany. Whilst making a delightful stay in that country about this time last year, the authors wrote to M. Elie de Beaumont from Pomarana, a letter dated Nov. 2, 1857, in which they stated, as the result of their united experiments, that the gases which are evolved with the boracic acid appear to consist, independently of a great quantity of aqueous vapour, of sulphuretted hydrogen and carbonic acid, which predominate; oxygen gas was only found in very minute quantities, and appeared to be altogether absent when the gases were collected with great care. These facts had, however, already been made known by M. Payen and Professor Schmidt. But MM. Ch. Deville and Leblanc added, in their letter of the 9th Nov. 1857, that in all the places they had visited they had found small quantities of carburetted hydrogen gas mixed with nitrogen (besides the gases already named), but which they had not then analysed.

We have now, since the date given above, some new details on this subject by the same authors. It would be useless here to enter into particulars concerning the manner in which the different gases were collected, measured, and analysed, and the different apparatus employed for this purpose; it will be sufficient, I think, to state that the aeriform fluids were collected with the greatest possible care, and their analysis conducted in such a manner as to ensure the greatest possible accuracy. An interesting paper presented by the authors to the *Academy of Sciences* at Paris, on the 23rd of August last, and subsequently published, furnishes us with the following facts*:—

1. The temperature of the gases, whether collected from the *soffioni* or from certain artesian wells, is, at the surface of the earth, as much as 100° (centigrade), but never exceeds this point, although the rapidity with which the gases are evolved seems, in many cases, to indicate an internal pressure.

2. All these gaseous emanations, from whatever point they proceed, contain the same gases, and pretty nearly always in the same proportions. Carbonic acid predominates in quantity, as M. Payen had previously made known. The quantity of sulphuretted hydrogen is to

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* Sur les émanations gazeuses qui accompaynent l'acide borique dans les Lagoni de la Toscane, par MM. Ch. Ste. Claire Deville et Leblanc.

that of the carbonic acid gas (if we consider the maximum) as 6·4 : 93·6 —oxygen appears to be completely absent. Nitrogen, on the contrary, is always present, in the proportion of from 2 to 3 per cent.

3, and finally, comes a fact which MM. Ch. Deville and Leblanc have been the first to observe: In every case these gaseous mixtures contain a certain quantity of free hydrogen gas and protocarbide of hydrogen ($C^2 H$) which both measured together attain, on an average, the same per-centage as the nitrogen. In some places, for instance, in a crack or fissure that joins Laderello and Castelnuovo, the proportion between these two combustible gases is nearly as 1 : 1.

The presence of hydrogen in these gaseous emanations of Tuscany affords a new feature of resemblance between them and the famous Geysers and Solfatara of Iceland, but up to the present time we are not aware that any of the acute observers who have studied the Iceland emanations have ever remarked in them the presence of carburetted hydrogen.

Closing the memoir quoted above, we will add here a few remarks upon boracic acid, as it is a very interesting natural production. Before it was discovered dissolved in the waters of the Tuscan *lagoni*, all the *borax* used in metallurgical operations, in medicine, and by the mineralogist in his essays with the blow-pipe, came from Asia—principally from India. Now, the boric acid of Tuscany is converted into borax (bi-borate of soda), for the arts and manufactures. The natural acid only contains 56 per cent. of pure acid, the remainder being water.

Boric acid (or boracic acid, as it is often called), though not volatile when pure, even at a high temperature, possesses the peculiar property of being volatile in watery vapour; so that, if a dissolution of it be distilled in a retort, a certain quantity of the acid will be found to have passed over with the steam, and will slowly deposit itself in the recipient, where it will crystallize in beautiful little white crystals. This is pretty nearly what takes place in nature. Besides the invisible vapour with which the air is constantly more or less charged, and which is every now and then condensed in the shape of clouds or fog, there is a constant supply of watery vapour, that makes its way (together with the gases of which we have been speaking above), through the fissures of certain rocks, either volcanos, solfatara, or calcareous and serpentine formations. These vapours are evolved from the earth near, at, or above boiling point (100° centigrade), with a hissing noise, and sometimes from high white columns of steam, that are visible from afar. This is the phenomenon to which the Italians have given the name of *fumarolla*, and which is nowhere more strikingly grand than in Tuscany, in the calcareous hills (often associated with serpentine) of Monte-Cerboli, Castelnuovo, and Monte-Rotondo.

This projected vapour carries with it boric acid and the gases noticed above. The vapours rise either directly from clefts in the rocks or from stagnant pools, in which they throw up small cones of mud; in places where the boric acid vapours permeate the fissures of the rocks, they deposit sulphur. The boric acid is dissolved by the water, which constantly condenses from the *fumarolle*, and forms the *lagoni*, from which it is extracted daily by a process of concentration. The gaseous emanations which arise with the steam were only very incompletely known until the recent investigations of MM. Deville and Leblanc.*

We read in a late number of the *Flensburger Zeitung*, that the peat-bogs of Suder-Brarup, in Schleswig, are become latterly a rich mine for antiquarians. It appears extremely probable that a small army was swallowed up in these peat-beds about 2,000 years ago. The soldiers had, it is supposed, endeavoured to cross the country in the winter, whilst the bogs were frozen, when they sank in and perished. Their remains are found in considerable quantities. "Never before," says the journal just quoted, "have organic substances, such as cloth, wool, leather, &c., been found in so perfect a state of preservation. Bows and arrows, spears, shields, and the like, buried in the peat some two thousand years ago, are almost in as good a state as if they had been manufactured only last year. Some of the objects are now exposed to public gaze at the *Hotel de Ville* of the town of Flensburg.

News has lately come from America to France (and is now travelling away over the Continent) of a man having been petrified alive after drinking some water contained in a geode he had broken open, the interior of which was beautifully crystallized. The *route* this marvellous history—which beats Chamisso's "Peter Schlemyl"—has travelled, is pretty nearly this:—From an article in the *Alta California* of the 20th of July last, it got into the *Athenæum*, of London, from thence into our Parisian contemporary, *Le Cosmos*, from which it has been copied into other journals. The French look upon this account as the last American *canard*.†

Errata in our Last.—P. 487, line 9, *for* make, *read* macle; p. 488, line 22, *for* titanite, *read* titanate; p. 490, lines 4, 8, and 14, *for* Muladetta, *read* Maladetta; p. 490, lines 9 and 17, *for* Nethon, *read* Nethou.

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* For further information on this subject, consult Payen in the "*Annales de Chimie et de Physique*," 1841; Larderel, "*Etablissements Industriels de l'acide borique en Tuscane;*" Sir. R. I. Murchison, "On the Vents of Hot Vapour in Tuscany," Quart. Journ. Geol. Soc., vol. vi., p. 367.

† I have not much doubt myself, from the extensive account given in the papers mentioned above, that the man died of a fit of apoplexy.—T. L. P.

REPORTS OF THE PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Proceedings of the Geological Society of London.—November 3, 1858.—The following communications were read :—

1. "On some Natural Pits on the Heaths of Dorsetshire." By the Rev. O. Fisher, M.A., F.G.S.

On Affpuddle Heath and Piddletown Heath, near Dorchester, the surface is pitted with numerous circular or oval hollows, like inverted cones. They usually vary from about 60 to 80 yards in circumference; but one measures 130 yards, and another, called "Culpepper's Dish," is 290 yards round; in the former the sloping sides are 23 yards high; in the latter 47 yards. After observing that these pits could not have been formed by the washing away of the underlying sand-beds, the author proceeded to show that their formation seemed to be due to the subsidence of the material into "sand-pipes" in the subjacent chalk, owing to the percolation of rain-water containing carbonic acid, which dissolved the chalk; and Mr. Fisher referred to the explanation of this process given by Mr. Prestwich in a paper formerly read before the Society.

As this process could have gone on only during a subaërial condition of the surface, and must have occupied a very long time, the author remarks that the larger pits on the Heaths referred to must have been formed by the sinking of the Eocene beds into enormous "sand-pipes" during an extended geological period, and that the area they occupy was dry land during all that time, and has been so ever since, and must, therefore, have formed islands or headlands in the sea which last filled the adjacent valleys, and gave them their present configuration.

As the formation of these pits was subsequent to the outspread of the superficial gravel of these Heaths, and previous to the last depression and elevation of the land, their date would be, perhaps, near that of the great mammalian fauna. The author also explained his views of the method by which the subsidence of the materials gave rise to the peculiar shape of the pits; and he observed that somewhat similar conical depressions have been noticed in process of formation at the present day.

2. "Notice of the occurrence of an Earthquake along the Northern Edge of the Granite of the Dartmouth District, on September 28, 1858." By G. Wareing Ormerod, Esq., F.G.S.

The shock was slight, and appears to have been confined to a very narrow district, that may be estimated as not exceeding eight miles in width, and running along the northerly edge of Dartmoor, along the line of junction of the granite and the altered carbonaceous rocks. The length of the area affected by the earthquake is about 21 miles, from Crediton on the east to the Fox and Hounds Inn, on the Tavistock Road, about seven miles from Okehampton. The shock seems to have taken a direction from east to west, to have occurred about eight o'clock in the evening, and to have lasted, where most severe, about 15 seconds.

3. "Notice of certain Veins of Granite in the Carbonaceous Rocks on the North and East of Dartmoor." By G. Wareing Ormerod, Esq., F.G.S.

The following localities are quoted by the author as affording more or less distinct evidence of granitic veins traversing the carbonaceous rocks. Near Meldon, two miles S.W. of Okehampton; Cocktree Moor; in the George of the Teign after leaving Hunts Tor; the most northerly point of Whyddon Park, and the hill-side nearly opposite; the hill-side above the Logan Stone; near Westerly Tor; on Sharpy Tor; on the road from Cranbrook Castle to Fingle Bridge; and the road down the hill to the west of Cranbrook Farm.

4. "On the Structure of some of the Siliceous Nodules of the Chalk." By N. T. Wetherell, Esq. Communicated by the President.

The author first described several specimens of the peculiar banded flints found in the chalk and in gravel, and of which he had made a large collection during several years. They usually exhibit a central longitudinal axis or narrow stem, crossed on its middle third by numerous short parallel stripes of alternately light and dark flint, and frequently terminated at each extremity by an irregular mass of flint, often clouded or grey. The axis occurs sometimes isolated, sometimes covered with a thin coating of grey flint only, and sometimes associated with only a few cross stripes of the banded structure. In some instances the banded flint has for its axis a sponge, or fragments of sponge.

The author had not found in the banded flint any sponge-tissue peculiar to it; in some instances, however, a silicified sponge appears to have been traversed by alternate lines of the light and dark colour analogous to those of the banded flints. In some instances a concentric arrangement of light and dark layers of flint occur around the two axes, or around isolated nuclei. Mr. Wetherell regarded this banded appearance in the flint as not being due to an organic structure, but to have originated in a peculiar arrangement of the siliceous matter around organic bodies, frequently long and stem-like, such as those of the Graphularia which supplied so many axial nuclei to the concretions in the London Clay.

Nov. 17.—5. "On some Fossils from South Africa." By G. W. Stow, Esq.

At the close of 1850 Mr. Stow and his party fell back into the interior to avoid the Kaffirs; in making this journey he collected largely the fossils in his route, and succeeded in preserving them on his return. In a plain at the foot of the Rhenosterberg, which is a branch of Sneewbergen range, he met with patches of ground strewed with nodular concretions and fossil wood, probably derived from the neighbouring mountains. These mountains are composed of horizontal strata. Eight of the beds at the foot of the Rhenosterberg are sandstones; above them are four layers of calcareous grit, or pebbly limestone, with other sandstones. These calcareous beds sometimes contain bones, but at one spot in the sandstone rock Mr. Stow discovered and chiselled out a nearly perfect skeleton of a small reptile. Other reptilian bones, and especially two small well-preserved skulls, rewarded his search; one of these belonged to a small Dicynodon, the other to a little undescribed reptile. Mr. Stow sent numerous specimens of the numerous nodular concretions and septaria from the rocks of this place, and also specimens of the concretional and other trap-rocks of two dykes that crossed the plain.

6. "On some Mineral Springs at Tehran, Persia." By the Hon. C. A. Murray.

The chief point in this paper was the description of the Ab-i-garm, a spring of hot water rising at about 2,000 feet above the bed of the river Laur, on one of the spurs of the Demavend, a lofty and slumbering volcano. The principal mineral ingredients in this water are sulphur and naphtha, and its temperature at its source is about 150° F.

7. "On Some Points in the Geology of South Africa." By Dr. R. N. Rubidge.

The author had observed in Namaqualand the occurrence of horizontal siliceous beds covering other siliceous inclined beds, the silification of the latter being apparently due to the infiltration of silica from the upper quartzose beds into the inclined beds below.

In this communication Dr. Rubidge details the evidences that he observed of such a process having taken place, and points out how the observations on some of the Namaqualand rocks by Mr. Bain, Mr. Bell. and Dr. Atherstone, respectively, tend to support his views in this respect. The inclined beds of this district are gneissic, and, in the instance referred to, very quartzose. The horizontal sandstone of this district he correlates with the Table-mountain sandstones, but in them he has found only a few obscure traces of fucoidal or other plants.

The author then passes on to the Cape district; and, first offering his testimony to the industry and general exactitude of Mr. Bain as a geologist, he proceeds to compare Mr. Bain's section of Mitchell's Pass with the section he made for himself on two hasty journeys.

Mr. Bain describes the indurated sandstone or quartzite in Mitchell's Pass as being, at first, horizontal, and then suddenly dipping at a short angle northward, so as to underlie the Devonian Schists of the Bokkeveld at Ceres, and to divide them from the slates of the Cape district. Dr. Rubidge points out the apparent difficulty of explaining such an inclination of the quartzite, the slates underlying both the inclined and horizontal portions not presenting any evidence of a difference in dip beneath the two portions of quartzite; and he suggests that the inclined beds of quartzite have nothing to do with the horizontal quartzite except that, being immediately beneath the horizontal siliceous beds, they have, by some means, been silicified from above, and thus rendered in appearance only identical. Taking this view, he considers that the inclined quartzite is a comformable successional portion of the schists and slates; the horizontal sandstone being of younger age than any of the schists or slates, and extending over them from Table Mountain to Orange River on the west, and to George on the east. On the north the schists are known to be of Devonian age by the fossils of the Bokkeveld, and the recent discovery of a few trilobites and spirifers at some spots in the slates of the southern districts of the Cape, near Cape St. Francis, at Klein Winterhoek, and near Jeffery's Bay, are considered by the author as corroborative of his view that the slates of the Cape are not divisible from the schists of the Bokkeveld, but are to be linked to them by the intercalated quartzites described in this portion of this paper; the schistose rocks of Ceres, Cape Town, and Malmesbury, (Silurian and carboniferous ? of Bain) having generally a similar strike and dip.

In the Eastern Province of the Cape Colony, Dr. Rubidge thinks that a similar condition of silification exists in the Zuurberg range, although no overlying horizontal sandstones are there seen. He describes in detail a section made by himself and Mr. R. Pinchin, along the road from Port Elizabeth to Somerset, which shows the inclined schistose beds, intercalated with a band of dark feldspathic rock (the claystone-porphyry of Bain), lying conformably on and passing into the quartzite of the Zuurberg on the south, and, after some great flexures of the quartzites, a similar series of conformable schistose rocks and feldspathic beds dip from the other side of the Zuurberg, in an opposite direction. Similar beds continue with diminishing dip as far as Vander Merwve's River, whence they rise again to the north to beyond Bushman's River (at Gower's), a little beyond which the feldspathic band again appears intercalated with them. The section then becomes obscured, until the Karoo beds are met with near Brak River, having a slight southerly dip, and probably abutting uncomformably against the schists near Callaghan's Inn. This section differs in some important features from that published by Mr. Bain of the same district.

Dr. Rubidge considers that the slaty beds flanking the Zuurberg on either side, and forming the synclinal trough at the Vander Merwve's River, are of the same age as the quartzites of the Zuurberg, which are, in his opinion, silicified by metamorphic influences: the interbedded feldspathic rock may also, in his opinion, be possibly of metamorphic origin

The author follows up his argument by reference to other parallel sections, and regards the plant-beds of Ecca, as well as those of the Great Fish River and the Vander Merwve's River, as being of Devonian age, and not belonging to the lower Karoo beds regarded by Mr. Bain as having a more southerly extension. Dr. Rubidge notices that some members of the two formations resemble each other so strongly that sometimes it is difficult to distinguish between them.

The plant-beds above referred to contain innumerable obscure vegetable fragments, like those of stems, reeds, &c., and in the rocks at Gower's, on Bushman's River, Dr. Rubidge has seen, besides fragmentary vegetable remains, some fine jointed stems. The plant-beds of the Karoo beds, at Bloemkop, contain two or more kinds of Glossopteris, very similar to those of the plant-beds of Central India and Bengal. Amongst the fossils sent by Dr. Rubidge, are several fossils from the Zwartzkop, and from the mouth of Sunday River; amongst the latter are some Belemnites and Hamites, probably of cretaceous age.

A large series of specimens from the Zuurberg and Vander Merwve's River accompanied this communication; and Dr. Rubidge also sent a series of fossil plants from the Dicynodon or Karoo beds of Bloemkop, with which Mr. C. J. Powell, of Graaf Reinett, had supplied him.

Warwickshire Naturalists' Field Club.—The Warwickshire Naturalists' and Archæologists' Field Club have held four very successful and agreeable meetings during the present year, and it is gratifying to note both the rapidly increasing prosperity of local societies of this kind, and their general establishment throughout the country.

The first meeting took place at Knowle, on the 20th of May. The locality was an interesting one to the geologists present, as there is a small outlier of Lias exhibited near the village, being the only trace of that rock seen in this district. It has been already described by that able and lamented geologist, the late Hugh Strickland, and was discovered by Dr. Lloyd, but there is one fact which seems to have been noticed on this visit for the first time, viz., the occurrence of a sandstone belonging to the zone of the bone-bed, containing casts of a shell, *Pullustra arenicola*, which always marks this part of the Liassic series; and although no actual bone-bed was observed, there can be no doubt of the occurrence of the basement-beds of the Lias in this neighbourhood identical with sections in Gloucestershire and other places. The point where this was observed was on the bank of the canal near the road to Hampton, and these lower strata of Lias rest immediately upon the red marl. The section, however, is small and very obscure, and it is highly probable that if a cutting were made at this spot the bone-bed itself would be detected. At present this is the farthest extension recognized to the north, although some portions were found by Mr. Strickland between Bristow and Wilmcote, in this county. The canal for some distance has been excavated in the Lias; but, as the best stone lies deep, and the whole is of very limited extent, it has been worked by a shaft, which is now closed, and not likely again to be opened, as the workings have not proved remunerative. The section as far as it could be examined, and judging from the limestone and shale lying about, evidently corresponds in most respects with the section at Wainlode Cliff and other places in Gloucestershire. Some of the shales contained beautiful specimens of *Ammonites planorbis*, spines and plates of *Cidaris*, and a small *Cardium;* with scales of fish and bones of Saurians. Several slabs of rough limestone were full of the *Ostrea liassica*, which distinguishes the "Ostrea-bed" in the neighbouring counties. There were some thick blocks of a hard compact blue limestone, which resembled the insect-bed, but probably belongs to another argillaceous stratum, higher up, which contains few fossils, except the minute foraminifer, the *Spirillina infima*, which occurs abundantly in Gloucestershire. There is reason to think this patch of Lias was at one time of far greater extent, although now not exceeding a mile and a half in one direction, but it probably never was of great vertical thickness.

As this club does not confine its excursions to Warwickshire, but visits other and neighbouring counties once at least during the season, the second meeting was held at the Wrekin, in Shropshire, on Tuesday, the 22nd of June. The party, which was a numerous one, proceeded by the Great Western Railway to Wellington, which they reached soon after 10 o'clock, and were conveyed in carriages to the Escal, a picturesque glen at the foot of the Wrekin. The day was sunny and fine, and, though very hot, the novelty and beauty of the scenery made the eager naturalists forget the toil of the steep ascent to the summit. Owing to a mistake, they did not see the small patch of carboniferous limestone visible only at two points in this district, and therefore were obliged to make their first attack with hammers and chisels on the hard felspathic igneous rocks which were seen in this narrow gorge, and which form a part of the main plutonic mass of the Wrekin, the whole of which has been upraised and has thrown off, and altered the Caradoc sandstone and other fossiliferous rocks on its flanks. This metamorphosed and crystallized Caradoc appeared only in a few places in the ascent. Gradually the fine view for which this hill is famous unfolded itself, in spite of the hazy atmosphere which obscured remoter objects. Seated on the crest of the hill, on the rough edges of the Syenite, Mr. Randall, an intelligent local geologist, gave a short geological description of the district, which forms Sir R. I. Murchison's grand typical region of Siluria, and which is unrivalled, both for the beauty of its scenery and the variety and interest of its geology.

On a clear day the Breiden hills, the Berwyn mountains, Snowdon, Cader Idris, and the Malverns, may be distinctly seen; as it was, however, the prospect was sufficiently extensive, ranging over the New Red Sandstone plain on the east and north, the bold and striking ridge of Wenlock Edge rising up above the Severn on the south, and in the more distant horizon the eye rested upon the curiously-shaped hills of Caer Caradoc, the Lawley, and the Longmynd in the back ground. At a glance is thus taken in nearly the whole of the formations forming the Silurian system, here and there loaded with fossils, and presenting those bold outlines which so strongly characterise these ancient rocks. Through woods and heather the members descended by Primrose Hill, and made at once for the fine ruins of Buildwas Abbey, beautifully situated on the banks of the Severn, where there is a good section of the Wenlock Shale exposed, abounding in fossils. Some little time was spent in examining these, and then, by a gradual ascent through a picturesque fairy dingle,* they reached the famous quarries at Bradeley and Gleedon hill; no very valuable specimens were obtained on this occasion; but the Wenlock limestone is here and elsewhere loaded with the characteristic shells, corals, and remains of encrinites. After a long and hot walk, the party were not sorry to sit down to dinner at the Wynnstay Arms, at Wenlock, where they were joined by the Vicar, the Mayor, and Mr. Brookes, an active and intelligent naturalist, and several of their friends. The usual business of the club having been transacted, after a few brief remarks on the geology of the neighbourhood by the vicar and Mr Randall, the members paid a short visit to the beautiful ruins of Wentsell Abbey, the fine old Town-hall, and the new Literary Institution and Museum lately built. At nine o'clock on the following morning the party, accompanied by Messrs Brookes and Randall, proceeded to Benthall-edge, which is, in fact, the prolongation of Wenlock-edge, as it terminates in this direction on the N.E. Here, again, the beauty of the scenery, and the abundant relics—especially corals—of that ancient Silurian epoch, long since passed away, made the forenoon pass too quickly away, and many would gladly have spent much longer time in this interesting field of research, being reluctantly compelled to hurry over well-stocked quarries and shady ravines which would doubtless have rewarded the careful search of the geologist and botanist. At Ironbridge the club divided, and the majority bent their way homewards. The zealous geologists who remained went to see the junction of the millstone-grit (of the coal-measures) with the Wenlock limestone, both of which dip at a high angle, and form a bold escarpment above the Severn. From thence they visited several of the ironstone-pits in the Colebrook Dale coal-field, which is particularly rich in iron-ore, the fossil plants which occur in it being associated with marine shells and other evidences of estuarine conditions. On arriving at Madeley, by the special invitation from Mr. Anstice, they inspected his choice collection of coal-fossils procured from the district, so rich in remains of plants, shells, crustacea (Limuli), and two species of insects which formerly were more frequently procured than of late years.

The next day was spent in a long ramble over a considerable portion of this coal-field, from Ironbridge to Ketley and Oakengates. Great quantities of ironstone piled up at the different pits were looked over, but few fossils were obtained; the largest number were observed at Ketley, where the sandstone contained some gigantic calamites and other plants, and when this was worked many fine specimens were procured. We have dwelt at length upon this ramble with the Warwickshire Field Club, not only on account of the interest which attaches to this particular excursion, but also to enable the student who may happen to visit the same neighbourhood to find out without difficulty the most instructive and attractive localities.

The third meeting of the club was held on the 27th of July, at Stratford-on-Avon, whence the geologists proceeded to visit the well-known Lias quarries at Wilmcote and Binton. The sections exhibited are tolerably uniform as to character, and consist, for the most part, of an alternating series of blue shale and limestone, forming the lower beds of the Lower Lias, and containing an abundance and variety of organic remains, amongst which the relics of insects are the most remarkable, though more frequent at Binton, where a large number have been collected.

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* At this spot the attention of the party was directed to certain shafts which had been sunk in the hill side, through the Wenlock shale, in a vain and hopeless search for *coal*. The owner of the property, it was stated, had already spent some thousands in this foolish attempt, and though cautioned of the utter impossibility of success, could not be persuaded to give it up.

These are not confined, as in Gloucestershire and elsewhere, to one or two argillaceous layers, but are distributed throughout a succession, amounting to four or five consecutive beds of the same lithological character. The shales and limestones also contain remains of saurians, fish, and crustacea, some of which are very fine and perfect, especially the splendid Plesiosaurus now in the Warwick Museum, a beautiful *Tetragonolepis pholidophorus*, and a large *Eryon Barroviensis*, *Ammonites* and oysters are abundant, but few other shells. The limestones are extensively used for paving and flooring, and are also made into hydraulic lime, for which purpose extensive works have been erected at Wilincote by Messrs Greaves and Kirsham, to whom the quarries belong. The bottom bed is a much harder stratum, called the "firestone," which easily takes a polish, and is therefore employed for chimney-pieces and other ornamental purposes. Some interesting fossils have lately been found by Mr. Fisher Tomes, one of the members, in a bed below the firestone, at Binton, consisting of Cidaris and spines, Bryozoa, and a few small corals. Mr. Kirshaw also discovered a new species of Teleosaurus (a genus not previously noticed so low down) in the limestones at Wilmcote. These facts were noticed with much interest by the members present, and some little discussion took place as to the mode of deposition of the alternating shales and limestones, and from whence they were derived. Mr. Brodie drew the attention of the club to the character and perfection of the insect-remains, and mentioned that the district was affected by faults, which were far more numerous than had been generally supposed.

The fourth and last meeting was held at Harbury, on the 7th of September, where a small but zealous body of geologists assembled at 10.30, and, after searching the spoil banks on the side of the railway-cutting, they examined in detail the fine and instructive section of Lias there exposed. This was traced upwards from the red marl to the higher beds visible, which form a series of nodular limestones and shales containing Ostrea and *Lima gigantea*, which have their representatives in Gloucestershire and other places where the Lias appears The lowest part of the section is somewhat obscured, but certain sandstones were noticed which were supposed to belong to the "bone-bed" series already recognized at Knowle. Some specimens of Posidonia (*Estheria*) were picked up, a species occurring in the lowest division of the Lias in Gloucestershire and Worcestershire, but the actual position *in situ* here could not be determined. A very conspicuous stratum, which may be traced for some distance along the line at the bottom, crops out at the surface between Harbury and Stockton, where it is quarried, and in the one locally termed White Lias. The surface is water-worn, and the rock contains a considerable quantity of iron, which gives it a tinge of red rather than white, which here, at all events, is not a very appropriate term, although, in places where there is less ferruginous matter it is really a white limestone. There were found in it very few fossils, except oysters, which are abundant, some spines of Cidaris, fragments of univalves, and the cast of a small lamellated coral. The superior strata above this (White Lias) consist of an alternation of blue shales and limestones, which abound in fossils. One band contains a mass of well-marked Fucoids; another is loaded with Ammonites and Nautili, some large specimens of *Lima antiquata*, *Modiola*, *Avicula*, *Pinna*, &c.; another is characterized by *Terebratula rimosa*, and towards the top of the section are certain nodular limestones, full of *Lima gigantea*, *Ostrea*, &c. This is best seen a little beyond at Messrs. Greaves and Kirshaw's quarry. With the exception of the White Lias, the rest of the section is identical with this portion of the series in Gloucestershire, though there are fewer beds of clay and shale in Warwickshire. In the former county, these are rarely seen in any one consecutive section, and therefore the one at Harbury presents many points of interest, and is well worthy of a visit.

The party adjourned to Leamington to dinner, after which Mr. Johnson read a short paper on certain facts in natural history, observed by him in the parish in which he resides. This meeting brought a most instructive and agreeable season to a close. The winter meeting is fixed for January in the coming year.

NOTES AND QUERIES.

Palæontographical Society.—Dear Sir,—The suggestion of Mr. Wiltshire in your number for last month (p. 493), respecting the desirability of bringing the works of the Palæontographical Society before the notice of your readers, I think is a very excellent one; and it appears to me that the sooner you can make the necessary arrangements for so doing the better. From the last annual report of the Council, it appears that up to the present time 2,589 species have been described by the various authors by 8,682 figures, and 3,857 pages of letter-press. The works for 1857 are in an advanced condition, and it is hoped that the volume will be out before the termination of the present year. The following is a list of the monographs which it contains :—

"British Fossil Reptiles," (continued) by Professor Owen, ten plates.
"Bryozoa of the Crag," by Professor Busk, eighteen plates.
"Carboniferous Brachiopoda of Great Britain," by Mr. Davidson, eight plates.
"British Oolitic Echinodermata," by Dr. Wright, fourteen plates.

The following is a list of the monographs in preparation for the year 1858 :—

"Fossil Reptilia of Great Britain," Part IX., by Professor Owen.
"British Carboniferous Brachiopoda," by Mr. Davidson.
"Shells of the Chalk," by Mr. Lucas Barrett.
"British Fossil Echinodermata," Part IV., by Dr. Wright.
"Eocene Mollusca," Part IV., by Mr. F. E. Edwards.
"British Fossil Crustacea," Part II., by Professor Bell.

It has often surprised me that so little notice has been taken by the scientific periodicals of the day of the publication of these splendid monographs, as the Society has now been in existence some eleven or twelve years. I have searched several of the volumes of "Timbs's Year Book of Facts," under the head of Geology, also the *Athenæum* and some other periodicals, without success; and with the exception of the notices in the annual addresses of the Presidents of the Geological Society these monographs appear to have been almost passed over in silence. A brief sketch of the circumstances which led to the origin and formation of the Palæontographical Society from the pen of its excellent secretary, Dr. Bowerbank, I am sure would be perused with much satisfaction by your numerous subscribers, especially if accompanied by remarks on the monographs now completed and in progress.

Dear Sir, yours very truly,

Highgate. Nathaniel Thomas Wetherell.

—We have already stated our intention to give a full notice of this Society, and its admirable publications; we shall do so in an early number of the volume of the ensuing year.

Ichthyodorulite from Staffordshire.—Dear Sir,—In the course of my researches in this district, I have found the exterior cast of what appears to me a plant in ironstone. The cavity was quite empty, not a trace of carbon being left. Although I have been collecting here for more than thirty years, I never met with a similar specimen before.

I send you casts of two of the fragments, which represent the original plant.

It may be common in other places, but I have not access to any work in which it is described. Will you favour me with the name of it?

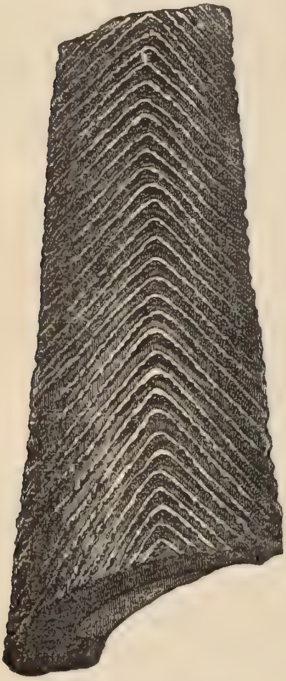
I have also found a portion of a large leaf of a fern, having a strong midrib: simple, undivided, like the hart's tongue, and which was probably of a leathery substance. The back is thickly spread with fructification; the *covers*, fixed by their centres, seem to place it in the order Polypodiaceæ. The specimen is in shaly ironstone.

I should like to send you samples of minute corals, &c., &c., from the Maestricht chalk.

Yours respectfully,

Hanley, Staffordshire,

L. J. Abington.



Gyracanthus tuberculatus.

—The fossil of which a cast has been transmitted to us, is not a plant, but a portion of an ichthyodorulite or fin-spine of a carboniferous placoid fish described and figured by Agassiz, under the name of Gyracanthus tuberculatus. We subjoin a figure of the original specimen, also a fragment, both base and apex being broken off.

The generic characters of the ichthyodorulites of the genus Gyrocanthus consist especially in the disposition of the oblique wrinkles which ornament their surface; these consist of ridges and deep grooves extending obliquely downwards from the middle of the anterior face of the spine towards the posterior edges, and abutting on the sides of the median line posterior to the longitudinal grove. Variations of form and of sculpturing may result from the position of these rays in the anterior or posterior dorsal fin; and as fragments of cartilaginous fish are found in the same beds with the spines upon which the genus Gyrocanthus is founded, such probably belonging to the same species. Diligent search should, therefore, be made for all fish remains found in the same strata from which our correspondent obtained his specimens.

The following are the ichthyodorulites of this genus hitherto figured:—

I. Gyracanthus formosus (Poiss, Foss., Vol. III., Tab. 5, f. 2-6), Coal Measures of Newcastle-on-Tyne, Sunderland, Alnwick in Northumberland, Dudley, Worcestershire. Freshwater Limestone of Burdie House

II. G. ornatus (Poiss, Foss., Vol. III., Tab. 1a, f. 1-7), Coal Measures, Sunderland.

IV. G. Alnwicensis (Poiss, Foss., Vol. III., Tab. 1a, f. 8), Coal Measures, Alnwick.

V. G. obliquus, M'Coy, Ann. Nat. His., 1848, pl. 2, p. 117. Carboniferous Rocks, Moyheeland, Ireland.

Agassiz has suggested that the ichthyodorulite in question may have belonged to the same species as that he has described under the name of *Gyracanthus formosus* the one being from the anterior dorsal and the other from the posterior dorsal fin.

We shall be pleased to receive the Maestricht specimens alluded to, and to afford our correspondent any assistance in his investigations.

THE PETRIFIED TREES AT LULWORTH COVE.—"SIR,—Would any of your readers inform me, through the medium of your 'Notes and Queries,' whether they have ever identified the strata east of Lulworth cove, Dorsetshire, with Dr. Buckland's plate, No. 57, Bridgewater Treatise. I confess to having spent a day at this very interesting spot in the endeavour to find, but without success, some trace of what Dr. Buckland so minutely and graphically described, namely, 'the inclined position of the petrified stumps of large Coniferæ, and of the bed of black mould and pebbles in which they grew.' The latter (the dirt-bed) I had no difficulty in discovering, though not presenting a section of more than six inches; but the petrified stumps of trees, as shown in Dr. Buckland's plate, were nowhere visible. I do not deny that in the position mentioned by him there are abundant remains of Coniferæ of an oblate spheroidal form, hollowed like a cone in the centre; but these could not have been mistaken for the silicified trunks of trees with branching roots, figured in the work alluded to.—I am, Sir, yours truly, K. H. G."

EAST KENT NATURAL HISTORY SOCIETY—"DEAR SIR,—In the 'Notes and Queries' of last month's GEOLOGIST, you state, 'We knew of the existence some years since of a Kent Natural History Society, the collection belonging to which was formerly at Maidstone, and part is still, we believe, in the museum of that town, and part in the museum at Dover.' Now, to prevent any of the numerous subscribers to the GEOLOGIST from being disappointed at not finding any trace of the Society, or the Natural History Museum, I beg to say that there never has been a natural history museum in Maidstone, of a public character; but a few years back, a gentleman of this town had an extensive private collection, which he kindly allowed the public to inspect, but which was afterwards sent to the Dover Museum, and no remnant of it now remains in Maidstone. As to the Society, I am sorry we could never muster strength enough to form one, but hope ere long, through the really invigorating effects of the GEOLOGIST, to succeed in doing so.—I am, Sir, yours truly, CIVIS, Maidstone."

STONE TO BEAR A WHITE HEAT.—"SIR,—I take the liberty of addressing you, requiring information relative to stones of sedimentary formation that will stand white heat. If such a stone could be found it would be of great use (cross sawn) for raising heat. Perhaps some of your correspondents might give information if such stone be found here or abroad.—Very respectfully, COLIN M'KENZIE DICK, 52 Poland Street, Oxford Street."

PLAN FOR CONDUCTING A GEOLOGICAL CLASS.—"SIR,—If you, through the medium of your excellentmagazine, could inform me of the best, or of any method of conducting a class for the purpose of studying geology, I should be much obliged to you.—I remain yours respectfully, J. B.—Huddersfield."—The answer to such a question involves two considerations, whether the intended class is to be out-door or in-door. Presuming it to be the latter, another point of consideration is, whether the course of instruction is to be long or short. If a short course, the geology may be gone into at once, and the principles upon which Sir Charles Lyell has framed his Manual may be most advantageously followed. If the course is to be long, subsidiary matter and details, as also the chemical, mineralogical, and other subordinate scientific phases of the science should be fully gone into. For this, Mr. Jukes's "Student's Manual" would give a good idea of a suitable plan.

CONTORTED FOSSILS FROM UPPER BALA ROCK.—"DEAR SIR,—I thank you for your kind attention to my inquiry respecting the "Scotch Drift," and enclosed I send you a little fossil which I cannot make out Will you kindly give me its name (if it has any) in your next number? I found a great number of the same kind on a slab of Upper Bala (Sedgwick), at Cefn Coch, North Wales; all of them were pointing in the same direction.—Dear Sir, yours faithfully, D. C. DAVIES.—Oswestry."—The specimen received is a fragment of a trilobite compressed in the direction of the cleavage of the containing rock. The contortion is too great to admit of a determination of the species.

MINERAL VEINS.—"DEAR SIR,—Perhaps your correspondent 'J. C.' will be so good as to particularize the examples on which he has come to the conclusion 'that mineral veins, in general, contain more iron in limestone than in siliceous strata.' Many will, I think, be slow to admit this as an axiom, without good proof being furnished, and will recal to mind, as I do, numerous instances of veins ingranite and siliceous schists abounding in iron, in the common conditions of gossan (earthy oxide), or of mundic (pyrites), and where the productiveness of valuable ores seems to be materially influenced by its presence. In addition, the great mass of copper-ore (copper-pyrites) from our chief British mining-districts is a 'double sulphide of iron and copper,' so that the quantity of the former metal in very many veins is more than meets the eye. The question opened by your correspondent is a very interesting one, and I hope he will himself contribute to its elucidation by giving the facts, from both the limestone and siliceous rocks, on which he forms his opinion.—Yours truly, HENRY THOMAS —Kennington Park."

MAMMALIAN REMAINS AT ST. ADDRESSE.—"Four years since, when I inspected the collection of M. Flambard, at Ingouville (Havre de Grâce), I observed in it a fragment of the grinder of an elephant, with very broad plates. The specimen was found on the neighbouring shore at St. Addresse; it must undoubtedly have come from the loam- or gravel-capping of the cliffs there, and as I was told no other similar remains had been previously found in that district, I have thought it worth while to send you a note of this fragment in connection with Mr. Prestwich's inquiry.—M."

PLEISTOCENE FOSSILS FROM BEDFORD.—"DEAR SIR,—I have had some fossils sent me from the neighbourhood of Bedford from Odell. Can you tell me what formation the surface-clay in that district is likely to be? I think the shells are *Cyclas obovata*, and either Cyrena trigonula or Astarte.—Yours very faithfully, J. B. Canterbury."—The indication of the fossils named is, that the clay enveloping them is of Pleistocene (the latest tertiary) age. Bedford itself is on the Oolitic formation, which, like other secondary deposits, is there, as very commonly in other districts, covered over by the pleistocene gravels and brick-earths. Search should be made for other shells than those named, and, even more particularly, for elephant and other mammalian bones in this deposit; such remains being of great value at this moment in the decision of certain very important geological questions.

CROCOISITE—AMBER—VARIATION OF GULF STREAM.—"SIR,—Will you tell me what the enclosed is; a piece weighing about four pounds was picked up in a field in Carmarthenshire. The outside presented a dull yellow, worn appearance, as seen on one side of the specimen, but its great weight induced us to break it; when the interior looked like a piece of lead-ore coloured with oxide of iron. Would you also kindly insert in the GEOLOGIST the following queries. 1st. Amber is supposed to be derived from the resins of extinct coniferæ. In the Bath Museum there is a piece of amber containing a fish. How did the fish get into the gum of a tree? 2nd. It was stated some time ago, that, owing to changes in the Gulf stream, we might expect a succession of warm summers. Is there any oscillation in the current? If the change is occasioned by the partial filling up of the old bed, how can the change be limited? Will it not go on until the warm current is thrown directly on the British Isles, and then altogether beyond our latitude?—CYMRO."—The specimen received is Crocoisite, a chromate of lead, known also as red-lead spar. It is used for a pigment, but the colour is not permanent. The mineralogical tests will be found in "Nicol's Manual of Mineralogy," page 387, and in other treatises on that science.

TRILOBITES FOUND IN THE EXCAVATION OF THE OXFORD AND WORCESTER RAILWAY.—We beg to acknowledge a communication from J. Gray, Esq., F.G.S., of Hagley, inclosing gutta-percha casts of fragments of Acidaspis found in the cutting of the Oxford and Worcester Railway.

PENNANT SANDSTONE.—Whence the term *Pennant*, as applied at Bristol to the sandstone series between the upper and the lower coal-measures?—CHARLES MARTEL.

BRITISH ASSOCIATION MEETING.

(Continued from page 504.)

"ON THE YORKSHIRE FLAGSTONE WITH FOSSILS," BY S. BAINES.—This paper was intended to exemplify a formation found in the Vale of the Calder and its tributaries.

On a bleak moor-side in the shelving formation of a fine sandstone, was a hollow dammed across for the accumulation of rain-water for scouring purposes, and which, in a few years, became filled up by a gradual deposit of sand. When dug out, there were presented finely laminated strata. In noticing this and other similar depositions, the author found that each layer was the deposit of one shower, or continous rain-fall; and in proportion to the quantity or time of each succeeding rain did the thickness of the deposit depend. Each layer is the result of one flood, a period of time then intervening after the sand was thus accumulated, during which the water smoothed its surface by a very gentle action, so that the smoothed bed would not allow the next flood's deposit to mingle with it. Each layer may be as thin as paper, or an inch or more thick, varying indeed with the circumstances of the case, from extreme tenuity to the uninterrupted deposition of ages, presenting many square yards in its mass, as in the great beds of freestone. One might compare this Yorkshire flag to the pond on a large scale, and regard it as the deposition of some ancient estuary, the waters of which washed the finer particles of the carboniferous sandstone from the Halifax and Todmorden districts. The deposition of the débris took place in still water, the faintest breeze causing ripple-marks, as shown by thousands of the slabs of freestone; and these flag-strata must have been, while forming, at times completely dry, for they abound in impressions of rain-drops (?) and tracks of Annelides.

The flag-formation is extremely barren of animal remains; the quarrymen, however, adhere doggedly to the assertion of live toads being occasionally found entombed in the rock. The author himself has not seen sufficient evidence of this. A quantity of large bones were dug from a quarry in South Owram, within a few yards of which impressions of a large foot have been met with. The flora in the Yorkshire flag is not so numerous as in the "crooked stone" above and below. The most common fossil-vegetable found in this formation and its kindred shales is the Calamite, some shales between the different strata abounding with its impressions.

The next most common plant is the Stigmaria, although but very rarely accompanied by the trunk, or Sigillaria; the heavy appendages, however, denote this to be a mud-plant or roots. Some most magnificent and perfect specimens of the Lepidodendron are found, and there are a few fossil-fruits similar to the *Trigonocarpum ovatum*; *Pecopteris nervosa* and *P. oreopteridis* are also met with.

The specimens referred to appear to be similar to the fossils of the Newcastle coal-field, figured in "Lindley and Hutton's Fossil Flora." There are in this district only two seams of coal, namely, Halifax "soft" and "hard" beds under the flags, before the great sandstone-grit base comes on; while there are thirty-three beds or bands of coal, with hundreds of varying strata overlying the flags within twenty miles eastward to old Normanton, forming a series more than seven hundred yards thick.

The author, in conclusion, refers to the excavation of the beautiful valley of the Calder in these strata, and remarks that in the newer Tertiary deposits in the tributary valleys, the boulders are of the local sandstone, while in that of the main valley of the Calder are boulders of almost every variety of rock, from granite and mountain-limestone, &c., to those of the ordinary sandstone.

Mr. T. P. Teale laid before the section the remains of Hippopotamus major, Elephas, Bos, and of smaller mammalia, from the valley of the Aire, near Leeds, accompanied by observations on the local character of the deposit in which they were embedded.

In Mr. J. G. Marshall's paper, an explanation of some geological phenomena of the lake district was attempted, on the supposition of these being due to metamorphic instead of igneous action.

The communications of Mr. W. Pengelly and Professor Ramsay, on the ossiferous cavern at Brixham, in Devonshire, gave an indication of what we may expect when the details of the cave shall be fully worked out. The operations there being carried on are under the auspices and direction of the Royal and Geological Societies, with the special object of determining, with the greatest possible exactitude, the mode of deposition, and the contents of the various successive deposits forming the floor of this cavern.

In the paper read by Mr. Pengelly the structure and formation of the cavern were described, and it was stated that upwards of 2,000 mammalian bones had already been exhumed, amongst which were mingled flint knives and other objects, evidently the work of a primitive race of men.

M. Boucher de Perthes, of Abbeville, the well-known French antiquary, several years ago pointed out the existence of flint weapons and other such artificial objects in the gravel drifts around that town, and with admirable perseverance that gentleman has accumulated, from various and distant localities, a magnificent suite of these objects, to the account of which, given in his lucid essay, we shall shortly draw fuller attention.

For many years past, too, we have had accounts of human remains, from gravel and other deposits, which have been too commonly regarded as apochryphal, or as the result of a careless commingling of the contents of proximate strata of very different ages.

On a question so important as the establishment of the first date of the existence of our race upon this planet, it is not right that the evidence should be open to even the shadow of imputation, and it is a matter of congratulation for all friends and votaries of our science, that the excavation of such an excellent example, as the Brixham cave really is, should have been undertaken by the Geological Society of London, and that, consequently, all the evidence in this instance will rest on no obscure foundation.

In Professor Ramsay's communication, it was stated that Dr. Falconer had already determined amongst the ossiferous remains of the Brixham cave the bones of an extinct rhinoceros, bos, horse, rein-deer, cave-bear, and hyæna.

Mr. David Page gave an account of a skeleton of a seal, of a widely-diverging variety (if not a distinct species) from the common *Phoca vitulina*, from the brick-earth at Springfield, near Stratheden, in Fifeshire, nine miles distant from St. Andrew's Bay, and five beyond the tidal influence of the estuary of the Eden. This pleistocene clay attains an elevation of 120 to 150 feet above the sea; and in the valley of the Eden are most marked traces of ancient sea-levels at 20, 40, 60, 90, 120, and 200 feet above the present level of the sea. Shells such as now exist on the neighbouring shores are met with at the lowest of these levels, beneath which there is still a submerged forest of oak, birch, hazel, alder, and other indigenous trees.

These remains of a seal were found in a bright red plastic clay, devoid of pebbles, or boulders, and evidently derived from the waste of the Old Red Sandstone of Upper Stratheden. It appears to have been a slow and quiescent deposit in comparatively deep water, and rests on a great thickness of dark blue tenaceous "boulder-clay," replete with boulders of syenite, granite, gneiss, greenstone, quartz, &c., and, from the disposition of the associated gravels and clays, it is evidently at least as old as the ancient 150 feet sea-level, and far older than those deposits in the Forth, Clyde, and Tay, which have yielded boreal shells, and remains of whales, deer, bos, &c.

In his "Further Contributions to the Paleontology of the 'Tilestones' of Scotland," Mr. Page observes that in Lanarkshire these strata seem to cap and form a portion of the Upper Silurian Series, while the Forfarshire flagstones constitute the basis of the Old Red Sandstone; hence, with a view to avoid present discussion, he classed the whole group as Silurio-Devonian. Since the Glasgow meeting he had added several new forms to the fossil fauna of the Lanarkshire beds, but no vegetable remains had as yet been detected in them. These new forms were, *Pterinea*, *Orthonota*, *Trincula*, *Avicula*, *Orthoceras*, *Eurypterus spinipes*, *E. clavipes*.

To the flora of the Forfarshire beds he had added several new and gigantic fucoids, a Lepidodendroid stem, and a fern (*Cyclopteris*); to the fauna, gigantic worm-tubes (*Scolithus*), annelidan tracks, and the remains apparently of an annelide itself, and two crustaceans, described and figured by himself under the generic names of *Kampecaris* and *Stylonurus*. A considerable number of ichthyodorulites had been discovered, and were as yet undescribed. To a small fish with a kite-shaped head and shagreen-like scales, armed with fin-spines, he had given the name of *Ictinocephalus granulatus*.

Specimens had also been obtained throwing additional light on the nature of previously partially known and obscure fossil organisms; thus we now possess a knowledge of the corneous eye-capsule, the pectoral and dorsal fins, and the true form of the great heterocercal tail of the *Cephalaspis*, and we could now restore it as a not inelegant fish, resembling in general contour the *Aspidophorus*, or armed "bull-head" of our coasts.

Mr. Page acknowledged his obligations to the labours of Mr. Powrie, of Reswallie, and to Mr. Slimon, of Lesmahagow, for the discovery and preservation of many of these new fossil forms.

REVIEWS.

The Canadian Journal. September, 1858.

AMONGST the other very nice articles in this number is one by Mr. Dumble, the engineer of the Cobourg and Peterborough Railway, on some natural phenomena of the expansion and contraction of ice by variations of temperature. In a territory like Canada, there are advantages, from climate and other causes, of studying on the grand scale the phenomena of ice and the effects of the congelation of large masses of water which we never possess in England; and many results are thus visible there, which, on the diminutive scale on which such natural operations occur in our island would be nearly inappreciable.

The mere facts that ice floats upon water and that vessels of any description, which contain water, fracture and burst from its congealing, are proofs sufficiently practical and familiar of the increase of its bulk by crystallization; but that ice itself should be capable of expanding and increasing in bulk is not equally well known, although many practical proofs are afforded. This property of expansion and contraction of ice aids in fracturing and reducing the gigantic iceberg; and but for these changes, from variations of temperature far below the freezing point, causing pressure, collapse, fracture, and disruption, the short Arctic summer would fail to open the Arctic seas. The phenomena recorded by Mr. Dumble are those occurring on Rice Lake, across which the Cobourg and Peterborough Railway is carried on a pile- and truss-bridge of timber. This bridge, on more southern waters, would have been considered a most suitable structure; but, owing to the almost irresistible expansive force of the ice, now presents the appearance of a complete wreck. The violent movement of ice on this lake is entirely due to contraction and expansion, solely from changes of temperature. The lake generally "takes" with ice during the month of December at a high-water level, which high level the dam across the outlet preserves until spring, and the movements of the ice are therefore divested of the influence of currents, nor are they subject to those other various causes, such as the differing temperatures of ice and sea-water, or wave action.

It is observed on Rice Lake that the action of the mid-day sun will set the *glare ice* immediately in motion. Warm winds, snow-storms, and rains, produce the like effect, and the motion is perceptible. "It is not shrinkage nor contraction, but, on the contrary, is a visible stretching and expanding of the field-ice generally towards the shore of the lake and of the islands." The movement of the ice is sometimes gradual, accompanied by a slight crackling noise; and sometimes the expansion is rapid and violent, the movement being by a series of vigorous jerks, accompanied by a hollow rumbling sound, seemingly from under the field-ice, while at intervals there occur sharp loud reports, like those of cannon.

That the ice does expand under such circumstances is evident, "as it may be seen creeping many feet on to the shores, without the appearance in the lake of any compensating fissures whatever." The force and violence with which the ice expands or shoves, depends entirely on the extent of the change of the temperature; and the most violent shoves of ice occur previous to rain-storms. A rise of temperature of 20° and upwards produces violent expansion. The effects of this expansive power is evidenced in the railway-bridge before mentioned:—"Portions of this structure on piles have been for long distances bent and inclined, even to an angle of 45°, in a most uniform and extraordinary manner—strong oak piles that would not bend, have been cracked and splintered; hundreds of heavy cap-timbers of sound pine have been snapped across like reeds, and heavy iron rails have been curved and doubled up by the almost irresistible pressure of the ice. Instances of trees growing on the shores having been torn up by the roots are of frequent occurrence. Large boulders, weighing two tons or more, have been lifted several feet from the shore, and then pressed into the timbers of the abutments of the bridge. Channels cut for the purpose of moving timber frequently close by the expansion of the field-ice, and the timbers are heaved out high and dry."

The greatest amount of expansion observed at any one time in an horizontal direction was six feet; and "when ice shoves on to the shores of lakes or islands, it presents different forms of fracture according to the nature of the resistance it meets with. Should the shore be low, the ice merely runs up and fractures at the ripple-mark. On the contrary, should the ice meet with resistance from a vertical shore or pier, a bursting up and piling of the fractured pieces would be the result."

Ice, when contracting, presents the reverse of this fractured appearance, and, according to Mr. Dumble, is susceptible of contraction to a very limited extent. He says he has witnessed sudden depressions of temperature on Rice Lake of 50°, "and yet the contraction of the ice, as made visible by open fissures, has not exceeded three inches." He thinks, however, that reported fissures of eighteen inches may have happened.

"When ice expands and is forced, perhaps, six feet on to the shore, should the temperature again fall, this ice, which had previously exceeded its limits, does not recede to its former position, neither will the main field separate over a few inches from the fractured portions on the shore. On the contrary, should the temperature again suddenly rise, a still further advance of perhaps the same distance is made on to the shore."

Such repeated expansions may occur many times during a winter, and yet little evidence of any contraction will appear. Channels of six feet wide opened for the purpose of isolating the Rice Lakes bridge, have been closed eight times within a month by the expansion of the field-ice. An extraordinary instance of ice-piling occurred on the embankment (twenty-six feet wide, and the rail on which is elevated about six feet); the ice shoving from both sides until the fractured pieces met in the centre of the track.

The expansion of the ice, as a rule, takes place from the centre of the mass, when the field is of equal density, and acted upon by any uniform cause, as the mid-day sun or warm winds; but the shoves are sometimes limited to particular areas or in special directions. This may happen from the different density of the ice, occasioned by the melting of snow-drifts on its surface, from its unequal thickness, from barrier tracts or islands, from particular winds, from other obstructive or modifying causes.

In an instance of the effects of the expansion of the ice from the centre of the field, Mr. Dumble tells us that "in December, 1857, the lake was covered with dense glare-ice five inches in thickness. The temperature was extremely low, ranging from minus 10° to minus 30° for some time after the ice formed; it suddenly rose to plus 30° previous to rain. The expansion which followed was of the most violent description. The truss-bridge superstructure moved two feet six inches on to Tic Island; the pile-bridge south of the island was forced four feet and a-half on to the south shore. The bridge was slightly shoved to the north, but was mainly preserved by the parallel channels that happened to be open for the purpose of isolating it in that direction. The centre of the bridge was not affected in the slightest degree, it being the neutral point. The ice was piled on to Tic Island from the north, east, and west, but on the south side it was torn away from the shore, exhibiting a fissure or opening of twenty inches in width."

Transactions of the Malvern Naturalists' Field Club. Part II., 1858. H. W. Lamb, Malvern.

In this part is printed the anniversary address of the President, the Rev. W. S. Symonds, F.G.S., which contains some valuable remarks upon the geology of the Malvern district, and a *résumé* of the local labours and discoveries of this excellent club. The address includes an interesting note, by Mr. J. W. Salter, of the Government Geological Survey, "On the Bone-bed at Brockhill."

The address is followed by a paper "On the Aquatic and Terrestrial Algæ of the Malverns." and "On remarkable Fungi found on the Malvern Hills." This part is illustrated by three lithographic plates of the Bands of Llandovery Sandstone near Malvern, the Bone-bed at Brockhill, and the Malvern Fungi.

Voices from the Rocks. 1857. London: Judd & Glass.

Mr. Rupert Jones has already pointed out, in the pages of this journal, the manner in which the exploded affair of the so-called human footprints is brought forward in the book under notice in spite of its express withdrawal by the authority there quoted (Dr. Mantell); and, if this one point of mis-statement had stood alone, we might charitably have regarded it as an oversight; but, when similar mis-statements are constant throughout the work, can we regard their occurrence as the result of inattention?

Of the opposition given by the author of the "Voices" to the doctrines of Hugh Miller, Buckland, Pye Smith, Hitchcock, and others, we make no comment. He has a right to dispute their inductions if he please; but he ought to do so fairly. Those men have all laboured faithfully, at least, and sincerely, whether successfully or not, to overcome a great difficulty; but it is not fair to raise a ridiculous position and then laugh at it, as is done by the anonymous author in the case of Mr. Miller. There is a want of justice to a deceased writer in the concluding passage of the third chapter, to which we refer:—"Suffice it to say, that the theory which requires us to suppose that fishes, of many species and high organization, existed, in as great numbers as the countless shoals which now people the waters, for many thousands of years in an ocean of liquid mud, must be at once dismissed as a simple absurdity." Mr. Miller was too good a geologist to have said any such thing.

The author of these "Voices," then, after disagreeing with all previous writers, brings himself to the condition recorded in the concluding sentence of chapter five :—"The uniform and deplorable failure of every attempt which has hitherto been made to bring the Mosaic narrative into harmony with the statements of modern geology should suggest to every Christian mind the inquiry—May not the assertions of geologists, after all, be unfounded in truth ? The facts of the science, of course, are altogether beyond dispute ; but may not the theories founded upon those facts be fallacious ? We will honestly," continues that author, "confess that, for many years past, this has been our conviction ; and, with the reader's permission, we will now place before him the grounds of our belief."

The first of these grounds is as fallacious as the statement of the footprints. We quote it from the book :—"The absence of the erosive action of water, as manifested in cutting valleys and gorges in the under-strata of the earth, is fatal to the theory that each formation has successively emerged from the sea and become the surface of the habitable world." Now, this is neither true nor fairly put. No real geologist believes that each and every formation, as here implied, has been raised into dry land and again submerged before the deposition of the next ; and wherever, in those cases of ancient elevation which are known, in which the former surfaces are preserved to us in the structure or super-position of the rocks, there we find the evidence of the influences and results of moving water and atmospheric action.

Every thorough geologist knows well the instances of erosion in the coal-measures,—over the surface of the chalk,—of numberless instances recorded as the effects of denudation and in the cases of unconformable super-position. And it would not be difficult for even tyros in the science to offer abundance of facts in disproof of the above unwarranted assertion.

The second ground is couched in these words :—"It is a strong presumption that the theories of modern geologists are altogether baseless, that no instance has ever been known of any alluvial soils, river-beds, forests *in situ*, or other traces of a habitable world having been discovered in the ancient strata of the earth."

We have heard of the man who collected a great crowd round Northumberland House upon the mere assertion that the stone lion's tail on the top of it *did* move. We think it would be easier to believe in the actual wagging of the Northumberland lion's ornamental extremity, than in this untenable assertion. Is it possible for any one to forget the everywhere-famous Purbeck dirt-bed—that old soil with the broken trees still rooted in it ? This was too glaring a fact to escape notice from even the author himself, who, in this very chapter, and knowing he could not pass it over in silence, evidently felt it would be too great assurance for even his slack modesty to deny it too positively. So, after quoting from Dr. Mantell, and putting upon a sentence of that geologist a construction it was never meant to bear, he adds :—"Now, although we would not positively deny that this is a real instance of a petrified ancient forest, yet we are far, very far, from being satisfied of the fact." Doubtless very far from being satisfied *with* the fact, because a fact fatal at once, without further discussion, to the author's design. But the attempts to explain away this fact—for one it undeniably is—are most bungling, and too transparent to take effect. The chief stress is laid upon the thickness of the dirt-bed, which is admitted to be from twelve to eighteen inches thick, being insufficient for the growth of forest trees. Any one who has walked over a limestone or hilly district, will know that forest trees will grow luxuriantly in such a thickness of soil as this ; and even on steep slopes trees of thirty and more feet in height will brave the storm, and find ample support in a soil of considerably less than a foot in thickness.

Again, are not all geologists cognizant of the lava-covered gravels of central France ? And are all the well-known and familiar facts of the coal-fields at home and abroad to be entirely ignored ? Not to mention the refutations from the Wealden, the brown-coal, and all the pages of et cæteras one could write down from memory.

As to the courses of the old rivers (about which the author of this book with such seeming confidence taunts geologists), that ignorance of them which he imputes does not reign. Something, much, indeed, is known, and more is daily gathering.

The evidence of the coal-measures was also too powerful a "voice" not to be listened to, but its speech has not been faithfully reported. We have, however, neither space nor patience to follow up and explode every detail. Our business is to fairly review the book, and to point out its merits or demerits ; but, for the sake of geology, we cannot pass over some of the chief points used in support of an argument that has for its object the overturning of established science, and a tendency to subvert its real interests and progress.

But to pass to the third point—the alleged slow deposition of the strata of the earth, than which, it is there said, "nothing in the whole system of modern geology is so opposed to common sense. No one with common sense would agree in this assertion after the perusal of any of the elementary treatises of Delabeche, Lyell, Phillips, Ansted, Mantell, Page. View a little chalk-dust through a microscope, or a few grains of Virginian Tertiary marl, and the hundreds of minute organic objects there visible would render it impossible—we repeat the word, *impossible* for any one with common sense, and using it, to doubt the slowness of the formation of those deposits. The quantities of the larger and more evident organisms embedded in all sedimentary strata, it is plain too, must have lived and died ; each must have had its term of life. No one will, no one can, believe that they were called into existence for the sole purpose of ornamenting a suddenly-formed mud-bank, or that they are "plastic forms moulded by nature," as delusions and ideal fictions that have never existed.

Great stress is laid upon the imbedding of fossil trees in the sandstones of the coal-measures at Craigleith, South Joggins, and other places. All the local details of these and such-like instances, must be gone minutely into, to prove the correct conditions under which such trees were entombed, and how it happens that they extend through so many strata, the formation of which must have taken great length of time. Suffice it to say, that these usually occur in sandstone, and we know that accumulations of sand are constantly liable to alterations of position and re-deposit, especially around even the slightest obstruction. Moreover, heavy bodies have a tendency to settle down through deposits of loose sand. We have seen large vessels wrecked on the Kentish coast *swaddle down*, as they there term it, and become nearly totally submerged in the course of a few years, and this without ever disturbing the level surface of the surrounding shore. Vessels wrecked on sands which are quick, or in a state of seething, as it may be termed, at high tide, from the influx of the water into the cavities between the particles of the incoherent mass, such as the notorious Goodwin Sands off Deal, are thus said to be very quickly swallowed unless they happen to be broken to pieces by the fury of the waves. In some cases the fossil-trees have undoubtedly grown on the spot. Lyell and Dawson's paper on the Joggins Coal, in the ninth volume of the "Quarterly Journal of the Geological Society" is highly interesting on this point.

We would, moreover, observe that sand-banks, in contradistinction to limestones, clays, and other forms of mud, are commonly of more or less rapid origin. A storm may accumulate a great bank of sand, but it would disperse and distribute, as a mere film over a large surface, the finer particles of mud ; and there is no reason whatever for drawing one general conclusion for primordial conditions, any more than in the phenomena going on around us. Circumstances in their variety now seem infinite, and they were equally so in the ancient state of things. We must regard each fact by itself to perceive the harmony of its connection with the grand universality and unity of nature.

The bone-caves show an evidence totally opposed to the statements of the author of the "Voices." So far from the ossiferous deposits in them being sudden or diluvial, we know, from calculations respecting bones already exhumed from many of them, that the number of individuals to which they belonged were commonly far more than could have been contained within the cubic dimensions of the cavity.

In some of the continental caves more than seventeen times the bulk containable has thus been estimated, while only a portion of the bone-deposit has been worked out.

Bit by bit we might thus go on through the whole book, refuting mis-statement after mis-statement, until we had at last written a treatise on geology in the accumulated refutations.

We content ourselves, however, with noticing one other statement. We quote it entire :—

"Although geology is professedly in its infancy—although it mutters only a feeble and inarticulate language—although its professors are notoriously at variance as to its fundamental positions, yet it has ventured to set itself in opposition to the declarations of the Scriptures of truth. Diverse theories concerning the past history of our globe swarm every season, and buzz like ephemera for a time, until they perish before a fresh generation of their kind.

"Various as these speculations are, however, they agree in one particular—they completely ignore and set at naught the revelation which it has pleased the Creator himself to give us respecting the generation of the heavens and of the earth when they were created.'"

Now, we protest against this. Geology is past its infancy ; it stands now undoubtedly a powerful science, and the language it speaks is neither feeble nor inarticulate. If the deductions of geology were but the puny lispings of a feeble infant, they would assuredly be beneath attack ; but it is their power and their influence that, rendering them formidable, makes it necessary for men, having private reasons for disliking truth, or an unfortunate incapacity for right-thinking, to make malicious, almost malignant, attacks upon men who, having real and deep religious feelings themselves, scorn to impugn the conscientious principles of others. Geology has never, by its true professors, been set in defiance of Scripture ; its truths have been most scrupulously taught, and those truths have been accumulated in one uninterrupted succession from first to last, and *against* the will and preconceived ideas and first belief of its votaries. Nay, the progress of the science has been greatly retarded by the laboured efforts of its earlier propagators, in their numerous attempts to build up the superstructure of the science on the basis of their preconceived and popular notions of the teachings of Divine Writ ; whilst surely Miller, M'Causeland, and others, have well shown how great sympathy there is between the teachings of inspiration and of science. Nor shall we say that the language of Geology is feeble and inarticulate because, being a choice and difficult one to acquire, it is not universally spoken. As well might we say the language of that great people of antiquity, the Egyptians, was feeble and inarticulate, because we could not read the hieroglyphical inscriptions on the massive pillars of their marvellous temples; or that the language of the Roman conquerors of the world was feeble and inarticulate because we had never been taught Latin. We might as well say that the polished inhabitants of ancient Greece, or that the educated Prussians, the metaphysical Germans, or the vivacious Parisians, of our own day, could only make known their individual wants and requirements to each other by mere gesticulations and unmeaning sounds, because we had not taken the pains to acquire a knowledge of their respective tongues.

Neither do diverse theories concerning the past history of our globe, swarming like ephemera every season, emanate from geologists. We grant that such attacks as the "Voices," and other productions more puerile in character, are constantly buzzing for a day and perishing like flies; and, if we wrote in the same spirit as the author of the "Voices," we might impute to their authors both the disregard of Scripture, which he imputes to geologists, and a total disregard and often designed imperception of truth, which has never been fairly charged against the latter. We, however, regard such productions more with pity than contempt, and still less with bitterness. Geologists contemplating the wisdom and benevolence of God, through (to our finite intellect) almost eternal ages—ages still only a fraction, as it were, of ages still more infinite, and still but an unreckonable flash of that incomprehensible eternity of the Godhead—contemplating the skill, the progress, and adaption of life and vegetation through uncountable ages to the purposes of a world-development; contemplating the design, the end, and purpose of the marvellous changes of the past—and inferring thereby the glorious future to which man is indubitably destined—geologists, we repeat, cannot be unimbued with deep religious feelings, and it is not fair for authors possibly ignorant of the meaning even of the epithets they use to class its professors and votaries in the category of irrationalists and false philosophers.

A Geological Map in relief of Brighton and its Environs for Eight Miles around, based on the Ordnance Survey, and Modelled from Nature, by J. Brion and Sons; *the Geology by* Ernest P. Wilkins, F.G.S., M.R.S.C., &c. Size twenty-four inches by twenty: Stanford, Charing Cross, 1858.

This map illustrates the physical features of the South Downs, and the design of the series, of which this is the second, (that of the Isle of Wight being already published), is to aid in popularizing the study of geology, by presenting to the eye faithful contours of the different geological formations of the British Isles. The horizontal measurements of the Ordnance Survey have been rigidly followed, and the vertical data have been supplied by Col. James, of the Ordnance. Every portion of the map has been modelled with care from nature, and the various bassets approximate closely to truth. The work is as correct in this respect as it can be in the absence of the more minute details of the Government Geological Survey. The geological portion has been executed under the joint direction of E. P. Wilkins, Esq., F.G.S., and P. J. Martin, Esq., F.G.S.

In recommending this map, as we willingly do, we would suggest that its utility, and that of all similar maps, would be greatly enhanced by having arrows inscribed at various places, indicating the dip of the strata. This should especially be done on each side of hill-ranges and valley-tracts, as those due to flexures and upheavals, to synclinal depressions, or down-throw faults, could thus be distinguished from those due to mere abrasion and denudation. The geological history of the area mapped in relief would thus be more thoroughly and more truthfully told. The more plentiful insertion of heights and levels above the sea would also be a useful improvement.

Geology and Mineralogy, considered with reference to Natural Theology. By the late Very Rev. William Buckland, D.D., F.R.S.: Routledge and Co., Farringdon Street. 1858.

"It is wonderful," says Longfellow, speaking of Goëthe, "when a great man dies, how the world goes on without him;" and in the ever-changing state of man's existence, this is true. The time and season of his active efforts have generally passed away with the individual, but those of his labours associated with the human passions or sympathies, often endure for ages; thus the book outlives its author, and becomes a necessity to even successive generations. In geological science, Dr. Buckland was one of the earliest and brightest stars; no man answered more truly in his particular vocation to the calls of his age than he; but the phases of geological progress with which he has been so worthily associated have passed away, and it is by the one work under notice that the link with posterity by his authorship and scientific efforts will be pre-eminently perpetuated.

Imbibing, as he naturally did, the "diluvial" doctrines of an older stage of the science, and supporting them by an elaborate volume, conspicuous for its learning and research, he had the moral boldness and honesty, upon maturer conviction, to demolish the hypothesis he had supported, and to aid in propagating, if he indeed did not really originate, those opposite views which are now universally accepted. It is not, however, in this brief notice that we have to do with the man, nor his general labours, but it is with a special book, written and adapted to a special purpose—the reconciliation of the Scriptural account of the creation of the earth with its geological history. This beautiful work—for beautiful it is, both in its composition, its diction, and its illustrations, as well as in its theme and design—caused at the time of its appearance a great sensation, and it still remains the most valuable popular disquisition upon fossils in the English or any other language. Modifications, amounting to little or no more than a few foot-notes, by three of the most eminent of modern naturalists, only have been made to this posthumous edition of the Bridgewater Treatise on Geology and Mineralogy, and yet the work is not behind any of the numerous others of its class and subject which have been produced in the interim between its first appearance and its third; and some of those have been from no inferior pens.

One new feature appears in the present publication as an addition to the original series of excellent plates—a representation of the restored forms of extinct saurians, by Mr. Waterhouse Hawkins.

However imperfect such attempts might be, it would be a worthy effort of the human mind to clothe anew with fleshly form the age-dry and stony bones of those extinct beings which have passed, like the visionary pictures of a dream, away, immeasurable ages before the first footstep of man pressed down the grassy pile of Eden's verdant carpet. Mr. Hawkins' pictures of these great beasts of the geologic eras have a life-like look, and an appearance of reality beyond the artistic skill displayed in their composition; and we willingly render our tribute of praise and thanks for his efforts in this direction, whether in regard to his lithographic pictures, his great models at the Crystal Palace, or those smaller statuettes which, from our mantel-pieces, familiarise our eyes with those extraordinary life-forms of primeval days.

Of the original book, we joined in praise with thousands of other readers, and of the present we would add that it has the additional advantage of an elaborate biography of its author from the hand of his son, the pleasure of reading which is enhanced by traces of filial affection, while of its truthfulness we are assured both by its style and the certainty of the intimate sources from which the writer has derived his materials, but the length of which we think might have been advantageously curtailed.

Many, indeed, we hope, will be successive editions of this memorable treatise, and the more numerous the readers, the more numerous will be those who will feel the noble sentiment and truth of its concluding passage, and will close its pages with the sincere conviction that "The earth, from her deep foundations, unites with the celestial orbs that roll through boundless space, to declare the glory and show forth the praise of their common Author and Preserver; and the voice of natural religion accords harmoniously with the testimonies of revelation in ascribing the origin of the universe to the will of one eternal and dominent Intelligence, the Almighty Lord and Supreme First Cause of all things that subsist, 'the same yesterday, to-day, and for ever,' 'before the mountains were brought forth, or even the earth or the world were made, God from everlasting, and world without end.'"

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